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VOLUME 41 NUMBER 3

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MARCH 1945

PUBLISHED MONTHLY BY AMERICAN MEDICAL ASSOCIATION, 535 NORTH DEARBORN STREET, CHICAGO 10, ILLINOIS. ANNUAL SUBSCRIPTION, $6.00

Entered as Second Class Matter Jan. 14, 1925, at the Postoffice at Chicago, Under the Act of Congress of March 3, 1879

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UME 41 MARCH 1945 NUMBER 3

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TREATMENT OF SINUSITIS WITH PENICILLIN

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AND
CAPTAIN WALTER P. WORK
MEDICAL CORPS, ARMY OF THE UNITED STATES

Cognizant of results being obtained in the tment of streptococcic and staphylococcic ctions with penicillin, we believed that this should also be effective in the therapy of ain types of sinusitis. During the past year used penicillin in some of the many cases uppurative sinus disease which came to our ntion. It is desirable to describe at the very inning the manner in which this study ved and the experiences which eventually us to employ penicillin in selected cases of puration of the paranasal sinuses. Because he rather striking results which followed its we decided to report our observations in e cases in which penicillin was employed er alone or in conjunction with surgical tment. Data were obtained which, we be-e, enable us to begin to suggest the indica-s for its use in the treatment of suppuration he sinuses.

ST CASES IN WHICH PENICILLIN WAS TRIED

n the first case in which we treated suppura-sinusitis with penicillin it produced a rapid dramatic cure.

27 year old aviation cadet suffered multiple frac-s of the maxillas and nasal bones in an airplane h. One month later a draining fistula developed ediately above the bridge of the nose. On Aug. 5, 3, fifty-eight days after the accident, this cadet came r our care. He still had at the glabella a drain-fistula through which a probe could be ed into the right frontal sinus, and pus was ing from the frontal and ethmoid sinuses bilaterally. r to coming to us, he had had intensive treatment sulfonamide compounds without any apparent effect the suppuration. While it was our opinion that a teral external frontoethmoidectomy would probably required to eradicate the infection, we were reluc-to resort to this radical procedure because of the tively short duration of the sinus disease. We ted him conservatively for nine weeks, adminis-g local treatments to the nose, irrigating the sinus ough the external fistula and then insufflating anilamide powder—all without effect. Because cul-s of the exudate from the fistula revealed Strepto-coccus viridans, which proved to be penicillin sensitive in vitro, and since we had just received our first supply of penicillin, we decided to try it in this case. The penicillin was given intramuscularly, 10,000 units every three hours for six days and then 5,000 units every three hours for five days—a total of 695,000 units. After thirty-six hours of treatment the fistula was closed and there was only a minimal amount of exudate in the nose. At the end of three days of treatment all discharge had disappeared, and it never recurred during the three months that he was kept under observation. Roentgenologic studies at the completion of the penicillin therapy showed clearing of the involved sinuses (fig. 1 *A*).

The second case in the trial series was that of a soldier who had a lifelong history of nasal allergy and purulent nasal discharge.

There was pus on the floor of the nose and in both middle meatuses; there was considerable polypoid degeneration of the typically allergic mucosa. Roentgenograms showed diffuse clouding of the maxillary antrums (fig. 1 *B*) and some clouding of the other sinuses. It was believed that the Caldwell-Luc operation was the most conservative procedure that offered the possibility of a cure; yet, seven weeks after this operation was performed bilaterally, he continued to have a profuse purulent nasal discharge. Culture of the exudate showed two strains of hemolytic Staphylococcus aureus, penicillin sensitive. Encouraged by the result obtained in the case previously described, penicillin was given to him intramuscularly, 15,000 units every three hours for ten days, the total dose being 900,000 units. At the completion of this therapy the pus had disappeared from the nose, only a thin mucoid type of discharge persisting. When he left the hospital one month later, there was no evidence of recurrence of the infection.

Our third and fourth observations of the effect of penicillin on infections of the sinuses came about in an unanticipated manner. Two of our soldier patients, while convalescing from unilateral external frontoethmoidectomy and the Caldwell-Luc operation, contracted gonorrhea, which proved to be resistant to treatment with sulfonamide drugs. In both instances, during the ninth postoperative week, the gonorrhea was treated with penicillin.

The first soldier was given 100,000 units of penicillin intramuscularly, i. e., ten injections of 10,000 units, administered at three hour intervals. Up to the day that he received the penicillin he had some exudate in his nose; twenty-four hours after its administration his nose was completely dry and remained that way during the

Presented at the meeting of the American Academy Ophthalmology and Otolaryngology, Chicago, Oct. 1944.

two months that he was kept under observation. In the second soldier the gonorrhea was cured by 50,000 units of penicillin divided into five doses. Although he had had some pus coming from the ethmoid sinus on the day preceding the penicillin therapy, the day after the treatment was finished the sinus was dry and was still dry eleven weeks later. Two weeks after the gonorrhea was cured, the maxillary sinus on the other side was operated on; it was filled with creamy pus, apparently unaffected by the 50,000 units of penicillin.

left side (fig. 2 *A*). Immediately following drainage a large abscess of the left frontal lobe of the brain, sulfadiazine was given orally, and at the same time penicillin was administered intramuscularly, 10,000 units every three hours. Six days later the nose was completely dry, and it remained so. Eleven days after his first operation, a second abscess of the left frontal lobe of the brain was drained. The following day, the Killian operation was done bilaterally. At operation the mucosa of the sinuses was thickened and some-

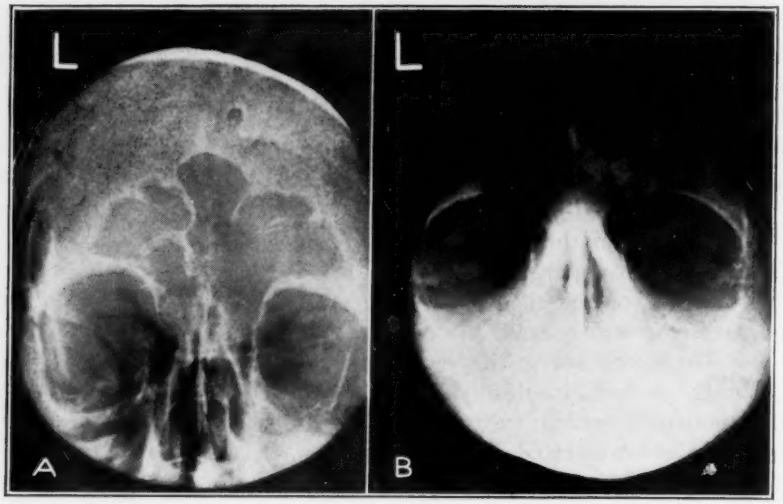

Fig. 1.—*A*, roentgenogram in the first trial case (multiple fractures of the bones of the face), demonstrating clouded frontal and ethmoid sinuses before penicillin therapy. *B*, roentgenogram in the second trial case (alleged with superimposed infection), showing diffuse clouding of the maxillary antrums.

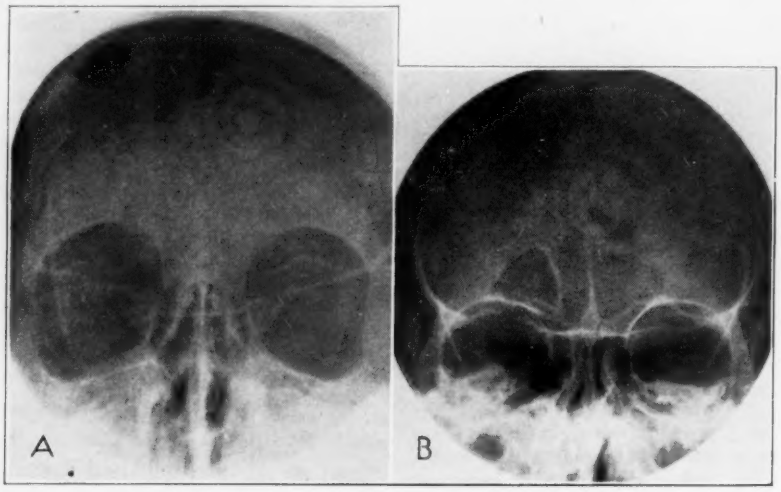

Fig. 2.—*A*, roentgenogram in the fifth trial case (abscesses of the brain), demonstrating the necrotic posterior wall of the frontal sinus. *B*, roentgenogram in the sixth trial case (osteomyelitis complicating old sinusitis), demonstrating localized osteomyelitis adjacent to the frontal sinus.

Soon thereafter our fifth observation was made.

An abscess of the brain was diagnosed in a soldier who had had a cold in the head accompanied by a constant dull headache in the region of the left frontal sinus over a period of three weeks. Some mucopus was coming through the left nasofrontal duct, and there was tenderness of the left frontal sinus; a review of roentgen films showed clouding of both frontal sinuses and an area of questionable destruction of the inner table on the

fibrotic but there was no pus in either frontal sinus. The inner table of both frontal sinuses was necrotic and was removed completely. There was no free pus over the dura, although it was covered with granulation tissue. At the completion of the operation, a third abscess of the brain, this one in the right frontal lobe, was drained. The administration of sulfadiazine and penicillin was continued, the dose of penicillin being increased to 15,000 units given every three hours. Ten days after operation the sinuses were healed completely. The exudate in the nose was not cultured; the abscess

the brain contained two organisms, hemolytic phylococcus albus and Str. viridans, both penicillin sitive. The patient received in all 124 Gm. of diazine and 4,090,000 units of penicillin. During six months that he was kept under observation he ained well, and, interestingly enough, during this od he did not show any signs of cerebral damage f mental deterioration.

Our sixth experience in this unplanned series s in a case of localized acute osteomyelitis the frontal bone complicating a two month sinus infection.

Creamy pus was coming from both nasofrontal ducts; re was some polypoid degeneration about the open- of the duct on the left side, and in the midline of the head was a draining fistula, passing to bare bone. addition to the clouding of the frontal and maxillary uses in the roentgenogram, there was a localized area osteomyelitis of the left side of the frontal bone, mediately adjacent to the frontal sinus (fig. 2 *B*). though our first impression was that it would prob- y be necessary to do the Killian operation bilaterally remove a portion of the left side of the frontal bone,

Fig. 3.—Roentgenogram in the seventh trial case rbital cellulitis). Note clouding of the frontal and left ethmoid sinuses.

o facts, viz., that the patient did not seem particularly and that the infecting organisms were penicillin sensi- e, decided us to try penicillin alone. The draining tula closed within twenty-four hours, and three days er the institution of treatment the nose was dry, the derness had disappeared from the frontal bone and he s completely asymptomatic. He received a total se of 925,000 units of penicillin. During the ten weeks t he was kept under observation, there was no recur- nce of symptoms or signs of infection. Roentgen films ken prior to his return to duty showed clearing of the uses but no significant change in the localized osteo- elitic area.

While the patient in the preceding case was under eatment, an officer was brought to the hospital with rbital cellulitis on the left side of three days' duration. e gave a history of a cold in the head for three weeks d suffered from constant pain in the area of the left ntal sinus during the week preceding admission. He s acutely ill, his temperature was 104 F., there was ffuse swelling of the left orbital tissues as well as roptosis and fixation of the eye. We were unable to cognize any fluctuation, nor was there any exudate his nose at the initial examination or at any sub- quent time. He was given penicillin intramuscularly, 10,000 units every three hours, for a total of 950,000 units. Within twenty-four hours after treatment was initiated, the temperature dropped, and the swelling of the orbital contents began to recede. At the end of six days, the eye and the adjacent tissues appeared normal. Roentgen films prior to his return to duty three weeks later showed clearing of the previously clouded frontal and left ethmoid sinuses (fig. 3). This was the seventh case in the trial series.

DESCRIPTION OF THE TOTAL SERIES

With the uniform success obtained in the foregoing small series of sinus infections in which penicillin had played a part in treatment we could not escape the conclusion that as penicillin became increasingly available we should employ it more extensively in various types of sinusitis with the view of determining the type of case in which it was effective and how it should be used to obtain the best results. Although the supply of penicillin increased, it did not reach the point where is could be used indiscriminately in all types of sinusitis. Moreover, at no time did our investigative urge cause us to neglect any of the generally accepted principles of treatment, since the primary concern in every instance was the welfare of the patient rather than the collection of data on the use of penicillin. Consequently, we do not have a series of cases in which a particular type of sinusitis was treated with penicillin but rather a group of cases in which penicillin used alone or as an adjunct of other forms of treatment was thought to offer the patient the greatest likelihood of rapid recovery in the light of what already had been learned through our own experience and that of others.[1]

METHODS AND TREATMENT

Including the patients previously described, we have treated at the time of this writing 46 patients for infection in and about the nose and sinuses. Of these, 11 were treated by irrigation of the maxillary antrums with solutions of penicillin, and the remaining 35 were treated by intramuscular injection of penicillin alone or in conjunction with radical surgical opening of the sinuses. We did not use penicillin in the treatment of patients who had uncomplicated acute sinusitis.

Certain patients who had subacute or early chronic sinusitis with only a small amount of pus in the nose and the sinuses were treated by repeated irrigations of the maxillary antrums with penicillin solutions containing from 250 to 1,000 units of the drug per cubic centimeter, 5 cc. being instilled into each antrum. Although the results obtained were almost uniformly good, remembering that similarly good results have often been obtained in this type of sinusitis with other methods of treatment we have decided not to attempt to interpret our observations in this small series but to state simply that this method appears to have merit and that we are continuing to use it. If the data thus obtained in a larger series of cases seem to warrant it, we shall probably report it separately at some later date.

1. Putney, F. J.: Personal communication to the authors.

REPORT OF TWENTY-EIGHT CASES BY DIAGNOSTIC GROUPS

The other cases in our series in which penicillin was used, apart from those already described, fall into five groups.

of polypoid tissue, in 2 instances there was still a p sistent mucoid discharge at the completion of treatm Table 2 shows the types of organisms and the amo of penicillin administered.

2. Four cases of orbital cellulitis: In 2 of these c the cellulitis occurred as a complication of frontoeth sinusitis, and in 2 it developed following multiple f

TABLE 1.—*First Cases of Chronic Suppurative Sinusitis in Which Treatment with Penicillin Was Tried*

Diagnosis	Duration	Organism	Penicillin Sensitive	Surgical Treatment	Interval Between Operation and Penicillin Therapy	Dosage of Penicillin	Duration of Pus	Period of Observation	Result
1. Bilateral chronic suppurative frontal and ethmoid sinusitis with external fistula	17 wk.	Str. viridans	+	None	.....	690,000 units	3 days	13 wk.	Condition cured
2. Bilateral chronic suppurative maxillary sinusitis, severe; ethmoid and frontal sinusitis, mild; allergic rhinitis	Years	Hemolytic Staph. aureus, strains 1 and 2	— +	Bilateral Caldwell-Luc operation	51 days	15,000 units every 3 hr.; total 900,000	6 days pus; then mucus	4 wk.	Condition improved, but mucoid exudate still seen in nose
3. Unilateral (right) chronic suppurative pansinusitis	Years	Nonhemolytic Staph. aureus	?	Right external frontoethmoidectomy; Caldwell-Luc operation	62 days	10,000 units every 3 hr., total 100,000 units, for gonorrhea	1 day	8 wk.	Condition cured
4. Chronic suppurative pansinusitis on left side; chronic suppurative maxillary sinusitis on right side	Years	Str. viridans; nonhemolytic Staph. aureus	? ?	Left external frontoethmoidectomy; Caldwell-Luc operation	65 days	10,000 units every 3 hr., total 50,000 units for gonorrhea	1 day	11 wk.	Condition left side cured; the right antr unaffected
5. Bilateral acute frontal sinusitis with abscess of the brain	3 wk.	Str. viridans; hemolytic Staph. albus from abscess of the brain	+ +	Bilateral Killian operation	Penicillin given for 11 days before sinus surgery	10,000 units every 3 hr. before operation; 15,000 units every 3 hr. after operation; total 4,090,000 units	6 days	39 wk.	Condition cured
6. Early chronic suppurative pansinusitis; localized osteomyelitis of the left side of the frontal bone	9 wk.	Str. viridans; nonhemolytic Staph. albus	+ +	.....	.....	10,000 units every 3 hr.; total 920,000 units	3 days	10 wk.	Condition cured
7. Orbital cellulitis secondary to acute frontal sinusitis	3 days	.....	—	.....	.....	10,000 units every 3 hr.; total 950,000 units	.....	3 wk.	Condition cured

TABLE 2.—*Cases of Allergic Rhinitis with Superimposed Infection*

Diagnosis	Duration	Organism	Penicillin Sensitive	Surgical Treatment	Interval Between Operation and Penicillin Therapy	Dosage of Penicillin	Duration of Pus	Period of Observation	Result
1. Allergic rhinitis with superimposed infection	7 mo.	Nonhemolytic Staph. albus; Str. viridans	+ +	Tonsillectomy and adenoidectomy	57 days	15,000 units every 3 hr.; total 960,000 units	4 days	11 wk.	Condition cured; pus and polypoid tissue disappeared
2. Allergic rhinitis with superimposed infection	5 mo.	Nonhemolytic Staph. albus and aureus; hemolytic Staph. albus	+ +	.....	.....	15,000 units every 3 hr.; total 465,000 units	3 days	3 wk.	Condition improved; mucus in nose
3. Allergic rhinitis with superimposed infection; nasal polypi	1 yr.	Staph. albus	+	Nasal polypectomy	34 days	Total 2,020,000 units; doses every 3 hr.	5 days	6 wk.	Condition improved; mucus in n

1. Three cases of severe allergic rhinitis with superimposed infection: In these penicillin was given intramuscularly. Though impressive features in each case were complete disappearance of pus and the recession

tures of the frontal sinuses and the nasal bones. each instance the response to penicillin therapy was ra with complete disappearance of the signs of orbi infection. In the last case, in which a draining orbi

a complicated a fifteen week old suppurative frontal itis (fig. 4*A*), the fistula healed completely and igns of infection in the sinus disappeared within -eight hours of the time penicillin was started.

Three cases of suppurative rhinosinusitis secondary rapnel wounds: Penicillin was administered pre-atively, then the intranasal adhesions were severed, fragmented and necrotic bone was removed, and an mpt was made to restore the normal anatomy of nose. In spite of the profuse purulent discharge from the nose and the sinuses within a few days after the penicillin was started. In our first cases in this particular group penicillin was not given until some time had elapsed following operation; in the latter cases it was given immediately after the surgical treatment, and in 3 instances it was started a day or two before the operation. The one failure was in a soldier whose surgical treatment was inadequate, as he still had extensive suppuration in the frontal and ethmoid sinuses (fig. 4*B*).

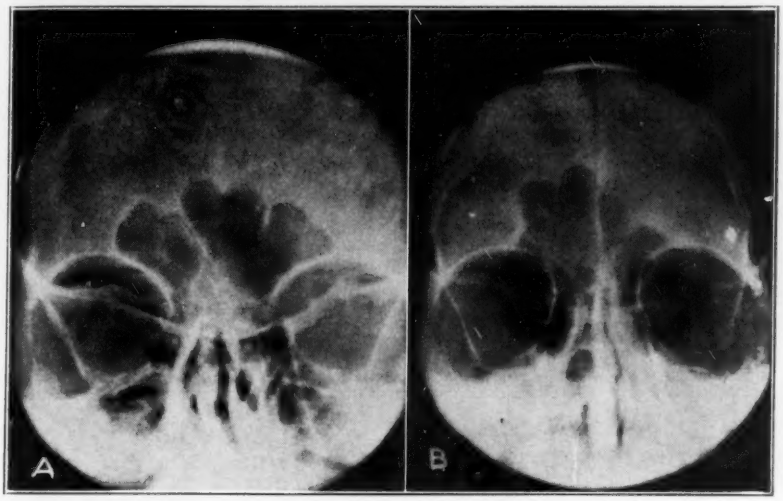

Fig. 4.—*A*, roentgenogram demonstrating clouded frontal sinus in the fourth case of orbital cellulitis (table 3). oentgenogram showing clouded frontal and ethmoid sinuses, unaltered by penicillin, in the fifth case of suppative sinusitis in which surgical treatment was confined to the maxillary antrums (table 5).

TABLE 3.—*Cases of Orbital Cellulitis*

Diagnosis	Duration	Organism	Penicillin Sensitive	Surgical Treatment	Interval Between Operation and Penicillin Therapy	Dosage of Penicillin	Duration of Pus	Period of Observation	Result
lateral orbital cellulitis econdary to acture of ontal sinuses	2 days	No culture	—	Open reduction of fracture	2 days	20,000 units every 3 hr.; total 1,920,000 units	.....	8 wk.	Condition cured
rbital cellutis, left side, econdary to ute exacerbaon of chronic inusitis on ft side	4 days	No culture	—	.....	.....	15,000 units every 3 hr.; total 1,300,000 units	.....	3 wk.	Orbital cellulitis cured; sinusitis improved
rbital cellutis, right side, econdary to acture of right ontal sinus	3 days	No culture	—	.....	.....	15,000 units every 3 hr.; total 2,125,000 units	.....	9 wk.	Condition cured
eft frontal inusitis, orbital cellulitis nd draining stula	15 wk.	Hemolytic Staph. aureus	+	Incision and drainage of orbit	95 days	15,000 units every 3 hr.; total 600,000 units	2 days	6 wk.	Condition cured

m the sinuses, once the adequate intranasal plastic ration was done and the intramuscular injection of icillin continued, there was complete disappearance ll suppuration of the sinuses.

Nine cases of suppurative sinusitis in which surgical tment was confined to the maxillary antrums: Six he patients were treated bilaterally and 3 unilaterally h the Caldwell-Luc operation. In addition to the gical treatment, penicillin was administered intrascularly in every case, with a cure in 8 of the 9 es. As is apparent in table 5, the exudate disappeared

5. Nine cases in which a radical operation on the frontal and ethmoid sinuses was performed with an external approach, combined in some instances with the Caldwell-Luc operation. Three of these patients had intracranial complications. All the patients were treated with intramuscular injections of penicillin postoperatively, and those with intracranial complications, preoperatively as well; in addition, the latter group received intensive sulfadiazine therapy. Recovery was complete in each instance. In case 3 of this particular group it is cardinal to emphasize that the infection of

TABLE 4.—*Cases of Sinusitis Secondary to Shrapnel Wounds*

Diagnosis	Duration	Organism	Penicillin Sensitive	Surgical Treatment	Interval Between Operation and Penicillin Therapy	Dosage of Penicillin	Duration of Pus	Period of Observation	Result
1. Chronic suppurative maxillary sinusitis with external fistula, secondary to shrapnel wounds of nose and sinuses	10 wk.	Hemolytic Staph. aureus	+	Submucous resection and intranasal plastic repair	Penicillin therapy preceded operation for 3 days and was continued postoperatively	15,000 units every 3 hr.; total 2,280,000 units	9 days	2 mo.	Condition cured
2. Chronic suppurative pansinusitis secondary to shrapnel wound	11 wk.	Hemolytic Staph. aureus	—	Submucous resection and intranasal plastic repair	Penicillin therapy preceded operation for 9 days and was continued postoperatively	20,000 units every 3 hr.; total 3,800,000 units	5 days	1 mo.	Condition improved before operation; cured after operation
3. Unilateral (right) chronic suppurative maxillary sinusitis secondary to shrapnel wound	11 wk.	Hemolytic Staph. aureus	—	Submucous resection and intranasal plastic repair	Penicillin therapy preceded operation for 6 days and was continued postoperatively	15,000 units every 3 hr.; total 2,100,000 units	4 days	1 mo.	Condition improved before operation; cured after operation

TABLE 5.—*Cases in Which Surgical Treatment Was Confined to Maxillary Antrums*

Diagnosis	Duration	Organism	Penicillin Sensitive	Surgical Treatment	Interval Between Operation and Penicillin Therapy	Dosage of Penicillin	Duration of Pus	Period of Observation	Result
1. Bilateral chronic suppurative maxillary sinusitis, severe on left, mild on right	1 yr.	Hemolytic Staph. aureus	+	Caldwell-Luc, left	95 days	15,000 units every 3 hr.; total 1,805,000 units	4 days	6 wk.	Condition left side cured by operation and penicillin; that on right side, by penicillin alone
2. Bilateral chronic suppurative maxillary sinusitis	1½ yr.	Hemolytic Staph. aureus	+	Caldwell-Luc, bilateral	43 days	15,000 units every 3 hr.; total 1,665,000 units	6 days	15 wk.	Condition cured
3. Bilateral chronic suppurative maxillary and ethmoid sinusitis	14 yr.	Hemolytic Staph. citreus	+	Caldwell-Luc, bilateral; left intranasal ethmoidectomy	64 days	15,000 units every 3 hr.; total 1,350,000 units	5 days	14 wk.	Condition improved; mucoid type of exudate in nose
4. Bilateral chronic suppurative maxillary sinusitis	3 yr.	Genus bacterium; nonhemolytic Staph. aureus	+ —	Caldwell-Luc, bilateral	13 days	15,000 units every 3 hr.; total 1,935,000 units	14 days	11 wk.	Condition improved; mucoid type of exudate in nose
5. Bilateral chronic suppurative maxillary sinusitis; frontal sinusitis ?	15 yr.	Hemolytic Staph. albus; nonhemolytic Staph. albus; gram-negative rod	+ + —	Caldwell-Luc. bilateral	24 hours before operation	15,000 units every 3 hr.; total 1,455,000 units	21 days	3 wk.	Condition unimproved; surgical treatment considered inadequate
6. Bilateral chronic suppurative maxillary sinusitis	1 yr.	Str. viridans; hemolytic Staph. albus	+ +	Caldwell-Luc, bilateral	None	20,000 units every 3 hr.; total 760,000 units	8 days	5 wk.	Condition cured
7. Left chronic suppurative maxillary sinusitis	3 yr.	Hemolytic Staph. aureus	+	Caldwell-Luc, left	None	20,000 units every 3 hr.; total 740,000 units	4 days	8 wk.	Condition cured
8. Left chronic suppurative maxillary sinusitis	1½ yr.	Hemolytic Staph. albus	+	Caldwell-Luc, left	24 hours before operation	20,000 units every 3 hr.; total 740,000 units	3 days	7 wk.	Condition cured
9. Bilateral chronic suppurative maxillary sinusitis	3 yr.	Hemolytic Staph. aureus	+	Caldwell-Luc, bilateral	6 days before operation	20,000 units every 3 hr.; total 960,000 units preoperatively; 2,560,000 units postoperatively	4 days	8 wk.	Condition cured

sinuses was much more severe on the left than the right side (fig. 5*A*), that the 935,000 units of cillin administered before any surgical procedure performed was sufficient to cure the mild infection lving the sinuses on the right but did not visibly the more severe infection on the other side. It not until the external frontoethmoidectomy and the lwell-Luc operation were performed on the left side a cure was effected. Similarly, in case 4, one of -standing chronic frontal sinusitis first treated sur-lly nine years before, 1,680,000 units of penicillin not eliminate the infection (fig. 5*B*). But once uate surgical treatment had been given and treat-t with penicillin continued, the nose and sinuses me dry on the third postoperative day. In case 5, of acute frontal sinusitis and osteomyelitis of the tal bone (fig. 5*C*), temporary improvement fol-

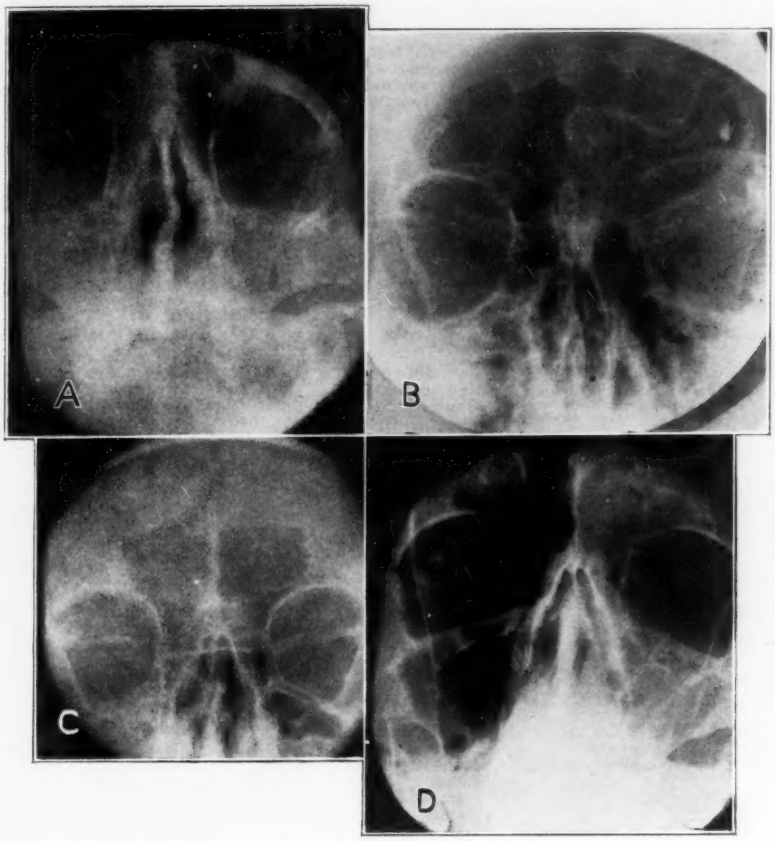

Fig. 5.—Roentgenograms illustrating cases of suppurative sinusitis in which radical external frontoethmoidec-y had to be performed before penicillin became effective (table 6). *A*, demonstrating some clouding of the sinuses he right side and diffuse clouding of the sinuses of the left side in the third case in this group. *B*, showing clouded right frontal sinus, unaffected by penicillin, in the fourth case. *C*, demonstrating clouding of the left ntal sinus and early osteomyelitis of the frontal bone in the fifth case. *D*, showing clouded sinuses, unaltered penicillin, in the eighth case of this group.

ed drainage of a subperiosteal abscess and adminis-ion of penicillin. When a radical operation on the ntal sinuses was done, because of signs of spreading ction, even though the man had been given 3,000,000 s of penicillin during the preceding fifteen days the erior wall of the sinus was found necrotic and there extensive osteomyelitis in the frontal bone with cted granulation tissue on the dura. Likewise, in 8 intensive penicillin therapy, given because of an acranial complication, had no apparent effect on the re purulent pansinusitis (fig. 5*D*); but once ade-te surgical treatment of these sinuses had been accomplished and penicillin administered a second time, there was no visible pus in the nose forty-eight hours after operation.

COMMENT

When we employed penicillin as a method of treating the first 2 patients in our series, viz., the aviation cadet in whom suppurative sinusitis developed secondary to injuries suffered in an airplane crash, and the soldier with localized osteomyelitis of the frontal bone complicating an infection of the frontal sinus of two months' duration, we gained the impression that intramuscular injections of penicillin alone might effect a cure in cases of chronic suppurative sinusitis of short duration. This impression was substantiated by the results obtained in at least 4 other cases: the 3 cases of chronic suppurative rhinosinusitis secondary to shrapnel wounds and the instance of orbital cellulitis complicating early chronic frontal sinusitis in which drainage had persisted for three months following earlier surgical incision. The results here have been so uniformly gratifying that we now treat all pa-

tients showing early chronic suppurative sinusitis with adequate amounts of penicillin intramuscularly, without regard to causes, before considering any type of surgical intervention.

so often a source of great anxiety, made
most prompt and dramatic recovery. Altho
the results in the cases of allergic rhinitis w
superimposed infection have been satisfact

TABLE 6.—*Cases in Which Radical Frontoethmoidectomy Was Performed*

Diagnosis	Duration	Organism	Penicillin Sensitive	Surgical Treatment	Interval Between Operation and Penicillin Therapy	Dosage of Penicillin	Duration of Pus	Period of Observation	Result
1. Unilateral (right) chronic suppurative pansinusitis; local osteomyelitis of maxilla; oromaxillary fistula secondary to tooth extraction	7 mo.	Nonhemolytic Staph. aureus	+	External frontoethmoidectomy and Caldwell-Luc operation on right side	56 days	10,000 units every 3 hr.; total 430,000 units	2 days	4 wk.	Condit cured
2. Bilateral chronic suppurative frontal sinusitis; left ethmoid sinusitis; osteomyelitis of left frontal sinus	17 yr.	Nonhemolytic Staph. albus	+	External frontoethmoidectomy and transfrontal sinusotomy on left side	None	20,000 units every 3 hr.; total 1,800,000 units	2 days	12 wk.	Condit cured
3. Bilateral chronic suppurative pansinusitis, severe on left, mild on right	1 yr.	Hemolytic Staph. albus	+	External frontoethmoidectomy and Caldwell-Luc operation on left side	Penicillin given for 5 weeks before operation and again 6 days after operation	15,000 units every 3 hr.; total 935,000 units before operation; 2,600,000 units after operation	5 days on right 8 days on left	10 wk.	Condit on right cured b penicill alone; t on left required radical operati and pen cillin
4. Unilateral (right) chronic suppurative frontal sinusitis	9 yr.	Staph. albus,	+	External operation on right frontal sinus	Penicillin given for 14 days before and then after operation	15,000 units every 3 hr.; total 1,680,000 units before operation; 1,400,000 units after operation	3 days after operation	7 wk.	Condit cured. effect u after op tion, ho ever
5. Unilateral (left) chronic suppurative pansinusitis	15 mo.	Hemolytic Staph. albus	+	External frontoethmoidectomy and Caldwell-Luc operation on left side	Penicillin given before operation for 48 hours and again after operation	20,000 units every 3 hr.; total 1,700,000 units	7 days	12 wk.	Condit cured
6. Acute left frontal sinusitis with osteomyelitis of frontal bone secondary to swimming	10 days	Nonhemolytic Staph. albus	+	Incision and drainage, Killian operation on left and resection of frontal bone	Penicillin given for 15 days before operation on sinus and again after operation	20,000 units every 3 hr.; total 3,000,000 units before operation; 1,750,000 units after operation	7 days	11 wk.	Condit cured. cess co tinued spread after adequa operati
7. Chronic suppurative left frontal and ethmoid sinusitis	6 mo.	Nonhemolytic Staph. albus	+	External left frontoethmoidectomy	Penicillin given 6 weeks before operation	15,000 units every 3 hr.; total 735,000 units	4 days	13 wk.	Result tionable At oper tion, 6 w after pe cillin the apy, chr product osteomy litis seen
8. Right chronic suppurative pansinusitis with intracranial complication	7 mo.	Streptococcus pyogenes	+	Trephination for abscess of brain, external right frontoethmoidectomy and Caldwell-Luc operation on right side	Penicillin given for complication 3 mo. before operation on sinus, again after operation on sinus	15,000 units every 3 hr.; total 480,000 units; hematuria; 15,000 units every 3 hr.; total 1,460,000 units	2 days	6 wk.	Sinusitis unaffect by peni alone; r cure aft operati
9. Bilateral acute frontal sinusitis; acute osteomyelitis of right side of frontal bone, epidural abscess and abscess of brain	3 mo.	Hemolytic Staph. albus; Str. viridans	+ +	Drainage of epidural abscess and abscess of brain	Penicillin given for 24 hours before drainage	20,000 units every 3 hr.; total 4,060,000 units	5 days	6 wk.	Sinusitis cured; osteomy litis qui escent

In our opinion, the value of penicillin in the treatment of orbital cellulitis is firmly established. The patients in this group of cases, which are

we cannot be too sanguine about them in t
the underlying pathologic state still persists a
reinfection can readily occur.

our operative cases, in which penicillin was in conjunction with adequate surgical treatt of the sinuses, our results have been far er than we were able to accomplish before icillin was available. The natural enthusiasm ired by these remarkable results might tempt to the conclusion that with penicillin freely lable one could abandon surgical procedures. his connection we call attention to our exence in 3 instances of intracranial complicaof sinus disease in which penicillin was zed over long periods and in adequate unts for treatment of the complication before gical intervention was attempted. In all 3 s operation revealed that the penicillin alone not cured the sinusitis; yet, following adee surgical treatment, the sinus was cured apid fashion. It would thus appear that in s of this long-standing infection one cannot ndon accepted surgical principles.

n the light of our clinical experience we have dually altered the plan of administering peni- to our operative patients. At first it was n only after many weeks had elapsed follow- operation, in an attempt to reduce the amount xudate in the nose. Noting the rapid cessa- of discharge resulting from the use of peni- n we began to give this immediately after ation. Here again the results were gratifyin that the discharge disappeared rapidly in most of the cases the nose and the sinuses e healed completely within two weeks of the of operation. In our most recent cases, g one step further, we began the administra- of penicillin forty-eight hours before operaon the sinuses. The postoperative reactions were minimal, and rapid and uneventful very followed. The results obtained have n so impressive that at the present time every ent who is to have radical surgical treatt for sinusitis receives penicillin intramuscularly every three hours for two days prior to operation, and its administration is continued postoperatively until we are convinced that the maximum benefit has been obtained.

Although some workers have recommended that penicillin be administered intravenously, we have never used that method. In our cases penicillin was always given intramuscularly and at three hour intervals. Our first patients received 10,000 units at each injection; later the dose was increased to 15,000 units, and at the present time we are giving 20,000 units every three hours, continuing the treatment without interruption until several days have elapsed after the last signs and symptoms have disappeared, or until we are convinced that nothing more can be gained by continued use of this drug.

SUMMARY

Penicillin is a most important adjunct to other forms of treatment for sinus disease and the complications of this disease. Our method of choice for administration has been to inject intramuscularly 20,000 units every three hours until the optimum result has been obtained. In the treatment of orbital cellulitis it has proved so dramatically effective that in our practice it has replaced every other method of treatment. In cases of allergic rhinitis with superimposed infection, while it eliminated all evidence of suppuration, we did not feel that it effected a permanent cure inasmuch as the underlying pathologic state, allergy, was still present. Patients with chronic suppurative sinusitis of relatively short duration can apparently be cured by penicillin alone. In long-standing chronic suppurative sinus disease, however, penicillin alone appeared to have little if any value; used in conjunction with adequate surgical treatment of such disease it accomplished rapid and complete cures.

PROPER USES OF NASAL PLASTIC OPERATIONS IN MILITARY PRACTICE

LIEUTENANT COMMANDER GEORGE V. WEBSTER, MC-V(S), U.S.N.R.

There are definite indications for employment of nasal plastic operations even in the urgent days of wartime military practice.[1] Their use should be restricted to correction of deformities acquired in military service, but an exception to this rule should be made when a preexisting deformity constitutes a definite hazard to health and, rarely, when gross disfigurement of the patient has resulted in an anxiety neurosis under the stress of war.

The need of plastic repair is self evident in gross destruction of the nose or portions of it by missiles, burns and other destructive agents, including cancer and infection, and it is not the purpose of this paper to review methods of compensating for these losses by free skin grafts or flaps. Only methods of correction of abnormalities of the bony and cartilaginous skeletal support of the nose are included under the term "nasal plastic";[2] they are discussed because their inclusion in military surgical practice might appear to some persons unwarranted.

GENERAL CONSIDERATIONS

Any change in the skeletal support of a nose results in a change in its appearance. This factor—cosmetic alteration—was originally responsible for the development of nasal plastic operations at the hands of unscrupulous "beauty surgeons," and it is difficult for the uninitiated to realize that from such unsavory beginnings present day general plastic and reconstruction surgeons have adopted and perfected technics which now serve purposes consistent with the highest aims in medicine.

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The opinions or assertions contained herein are the private ones of the writer, and are not to be construed as official or reflecting the views of the Navy Department or the Naval Service at large.

1. O'Connor, G. B., and Pierce, G. W.: Refrigerated Cartilage Isografts, Surg., Gynec. & Obst. **67:** 796-798 (Dec.) 1938.

2. Dupertuis, S. M.: Actual Growth of Young Cartilage Transplants in Rabbits, Arch. Surg. **43:**32-63 (July) 1941.

The modern nasal plastic operation is a conducted, safe procedure which requires a erate period of hospitalization, depending on extent of the surgical correction required. with other operations, this period of disab is slightly longer in military than in civilian p tice, because the patient must leave the hos fit for full military duty. Convalescence is prolonged until he regains his full health strength.

Local anesthesia is preferable for nasal pl operations because of the hemostatic effe epinephrine and the facilitation of dissection fluid distention of the tissues. Preservation all pharyngeal reflexes with local anesth serves, as with most oral and nasal surg procedures, to prevent aspiration and pulmon complications. General anesthesia can be g to an apprehensive patient, though the pres of the external connections of an intratrach tube is inconvenient to the operator. W autogenous cartilage is being used for graf to the nose, the rare danger of opening the pl must be borne in mind, and positive press anesthesia may be necessary. When proper a thetic methods are used, discomfort from n plastic operations is minimal.

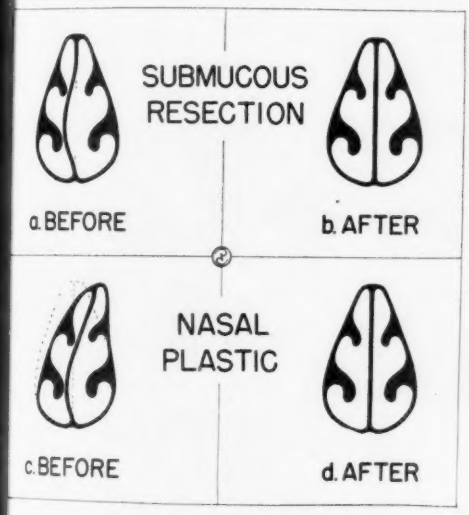
Much corrective surgery of the nose could prevented if adequate primary care were g to nasal injuries. The malleability of bro fragments within a few hours or even days a the injury permits restoration of normal n function and appearance in the easiest poss manner. A curved hemostatic clamp cove with rubber tubing can be introduced into cocainized nose and the depressed fragme elevated into normal position. Lateral de tions of the nose can be corrected by man external pressure, frequently without the us any anesthetic except morphine. Such red tions result in satisfactory maintenance of p tion unless excessive comminution of fragme is present, when rather elaborate splinting a traction devices are sometimes necessary.

CLINICAL APPLICATION

Nasal skeletal deformities resulting in trauma fall easily into two groups: (1) late

ation of the bony bridge, with or without rations in the cartilaginous septum or tip, (2) collapse of the nasal bridge from frac- producing "saddle" deformity.

orrection of Deviation of the Bridge.—De- ions of the bony bridge usually occur with- depression of the profile, though a "hump," orsal deformity, may be present. Such a rmity is frequently familial or results from ma at such an early age that the patient no recollection of injury; it can as easily r from trauma in adult life. Whatever the e, obstructed breathing space and faulty nage from the paranasal sinuses can occur as surely from a deflected bony bridge as a deviated septum (fig. 1). Surgical cor- on is indicated by complaints of impaired thing, postnasal drip, frequent head colds,



g. 1.—Diagrammatic oblique cross section of the . (*a*) deviated nasal septum, which produces im- d breathing on the right. (*b*) correction by sub- ous resection. (*c*) deviated bony bridge (septum is he midline), producing impaired breathing on the t. (*d*) correction by nasal plastic operation.

gic states or headache in the region of the nasal sinuses when physical examination re- s definitely impaired breathing space and ty drainage of the sinuses is due to a de- ed bony bridge (fig. 2). Removal of the sal prominence is "cosmetic" in a sense, but s incidental to the osteotomy necessary for rection of the bony deviation.

orrection of Depressed Nasal Framework.— pression of the nasal skeletal framework pro- es a reduction in the normal airway and of prominence of the nose. This produces familiar "pugilist's countenance." The tip the nose is also depressed in this type of injury, because of loss of cartilaginous support at the tip. Restoration of support for the bridge and tip by a cartilage transplant with a columellar post elevates the tip and improves breathing space as well as appearance. Correction of many saddle-like deformities may be accomplished by osteotomy and by placing existing bony fragments in new positions, at the same time making adjustments in the cartilaginous skeleton of the nose, without resorting to an accessory implant of cartilage (fig. 3). Frequently, however, injury has been so great as to prevent normal restoration with the raw materials at hand, and a graft of cartilage must be used (fig. 4). In this clinic it has been the practice to use fresh

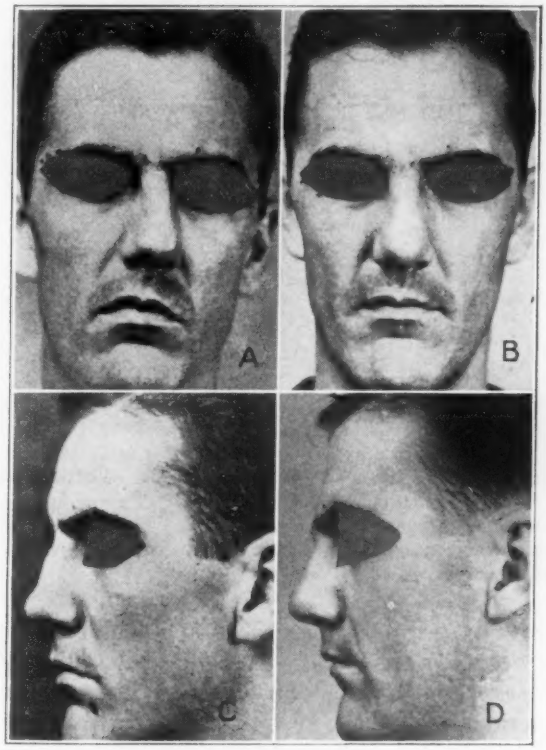


Fig. 2.—Patient S.: A deviated bony bridge had been present since an injury in childhood. Drainage from the sinuses was faulty because of obstruction on the right side. *A*, front view—preoperative appearance. *B*, front view—postoperative appearance. *C*, side view—preoperative appearance. *D*, side view—postoperative appearance.

autogenous cartilage, though preserved cartilage is certainly used abundantly by other plastic surgeons.[3] The principal features felt to be in favor of the use of autogenous cartilage are solidity, resistance to infection, early fixation of the graft by connective tissue and, in young per-

3. Injuries to Nose, in Ireland, M. W.: The Medical Department of the United States Army in the World War, Washington, D. C., Government Printing Office, 1924, vol. 11, pt. 2, pp. 522-549.

sons, growth.[4] Disadvantages are additional risk, discomfort and the hospitalization necessary to obtain fresh autogenous cartilage at the time of operation. These disadvantages are not serious for young, healthy adults.

Specialized Applications.—In addition to the two main subdivisions of nasal plastic operations,

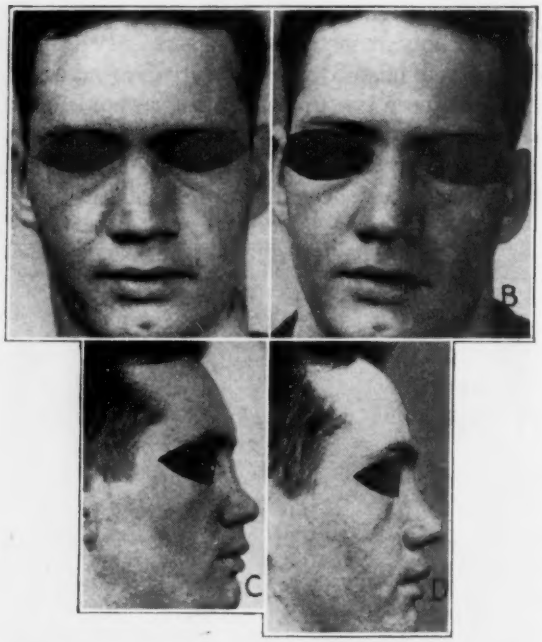


Fig. 3.—Patient G.: "Boxing fracture" of the nose, incurred during authorized recreation. Correction produced without use of a cartilage graft by elevating the crushed fragments. *A*, front view—preoperative appearance. *B*, front view—postoperative appearance. *C*, side view—preoperative appearance. *D*, side view—postoperative appearance.

certain specialized applications of nasal plastic procedures are found to be indicated in certain cases. One of the commonest of these is correction of a prolonged septum which is markedly deviated and obstructs breathing through one naris. Septal deviations of this type are occasionally great enough to produce actual dislocation of the alar cartilages and the nasal tip and not infrequently form an unsightly protrusion from a naris (fig. 5). Submucous resection of septal cartilage alone would give an odd shape to the nasal tip. Combination of submucous resection with corrections of the alar cartilages and the dorsal ridge of the septum takes but a few more minutes at the operating table, and the end result is much more pleasing.

An injury to the nasal skeleton is frequently accompanied by laceration. In the original care of the injury little thought may have been g to late contracture of scar tissue resulting f the lacerations, and when scars completely circle the nasal passages, constriction may so marked as to produce disabling impairme breathing due to stenosis (fig. 6). This condi must be corrected before the bridge and the are elevated.

Postoperative deformities following exces cartilaginous septal resections occasionally p duce collapse of the alae or of the nasal against the upper lip. When this is the c a patient may manually elevate the tip of nose with thumb and forefinger to improve breathing. Prompt improvement follows a g of cartilage with columellar support (fig. 7).

The emotional effect of changes in appe ance is sometimes underestimated,[5] and a g nasal deformity may produce radical change personality in sensitive persons. It is occasi ally justifiable, when the patient's work and

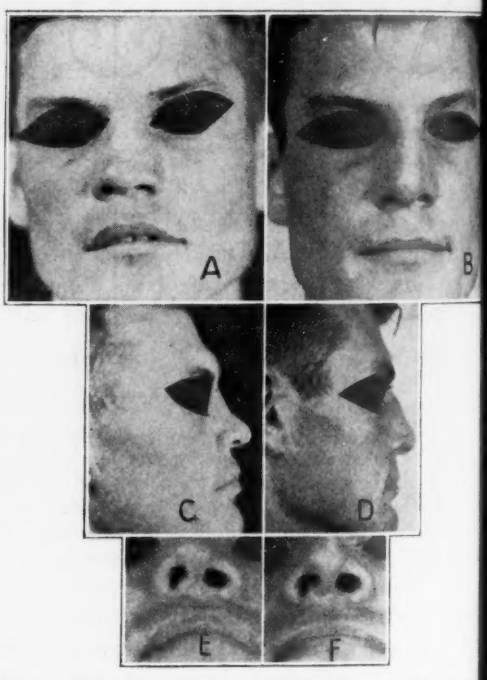


Fig. 4.—Patient D.: Crushing injury of the b bridge and cartilaginous tip which occurred from gun butt injury while the patient was in military serv Prompt reduction might have made plastic operat unnecessary. An autogenous cartilage graft was u for correction. *A*, front view—preoperative appearan *B*, front view—postoperative appearance. *C*, side v —preoperative appearance. *D*, side view—postoperat appearance. *E*, inferior view—preoperative appearan *F*, inferior view—postoperative appearance.

4. New, G. B.: Traumatic Deformities of the Nose and Other Bones of the Face, Surg., Gynec. & Obst. **64**:532-537 (Feb. 15) 1937.

5. Blair, V. P., and Brown, J. B.: Nasal Abn malities, Fancied and Real, Surg., Gynec. & Obst. 5 797-819 (Dec.) 1931.

rator's time permit, to correct a deformity ch is causing a fixation neurosis (fig. 8). need only see the manifest changes in such erson and experience the almost embarrassing titude expressed by him to realize that by icious employment of corrective procedures

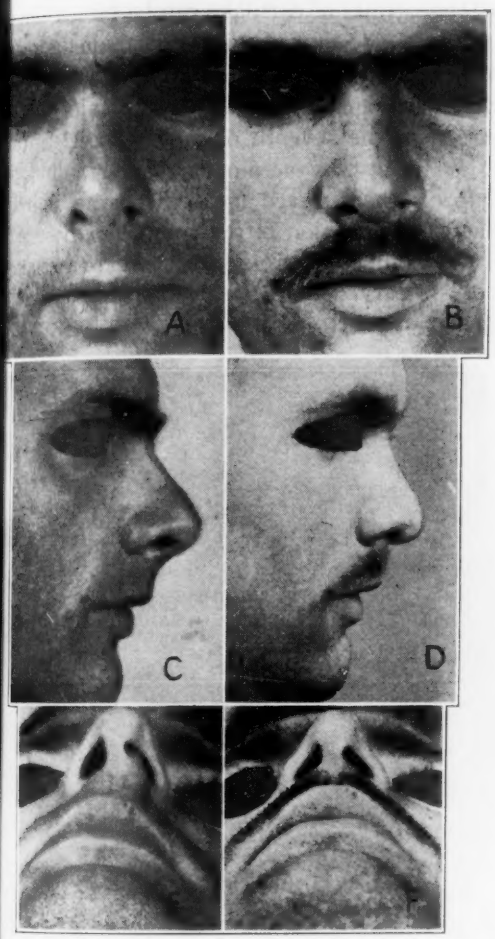


Fig. 5.—Patient R.: Old deviation of the septal tip th moderate deformity of the cartilages of the nasal . *A*, front view—preoperative appearance. *B*, front w—postoperative appearance. *C*, side view—pre-rative appearance. (Note flattened nasolabial angle.) side view—postoperative appearance. (Nasolabial gle restored to right angle.) *E*, inferior view—pre-rative appearance (note the left naris nearly com-tely obstructed by the protruding septal tip). *F*, in-ior view—postoperative appearance.

man may be salvaged for greater usefulness military life.

TECHNICAL PROCEDURES

The technical procedures of repair are well out-ed by Joseph [6] and Safian.[7] They begin with sic incisons beneath the alar cartilage inside the vestibule, the curved double-sharp-point Joseph knife being used. This knife passes dorsal to the triangular cartilages and undermines the skin and subcutaneous tissue of the nose. The periosteum of the bridge is then elevated and osteotomy performed by sawing through the bone. If there is a "hump," this osteotomy is made tranversely with the bayonet saw, the bone being cut at the line of the new profile. If there is no hump, the saw cuts are made vertically, parallel to the septum. A second incision is made in the floor of each vestibule, and the dissection carried up along the outer border of the nasal process of the maxilla, beginning at the lower corner of the pyramidal fossa. Lateral osteotomies are then made, as low on the base of the nose as possible, the angle saws or the chisels being utilized for this purpose. When the bony bridge of the nose is deviated to one side, a wedge resection of bone is made on the longer side by utilizing double saw cuts. The bony attachments

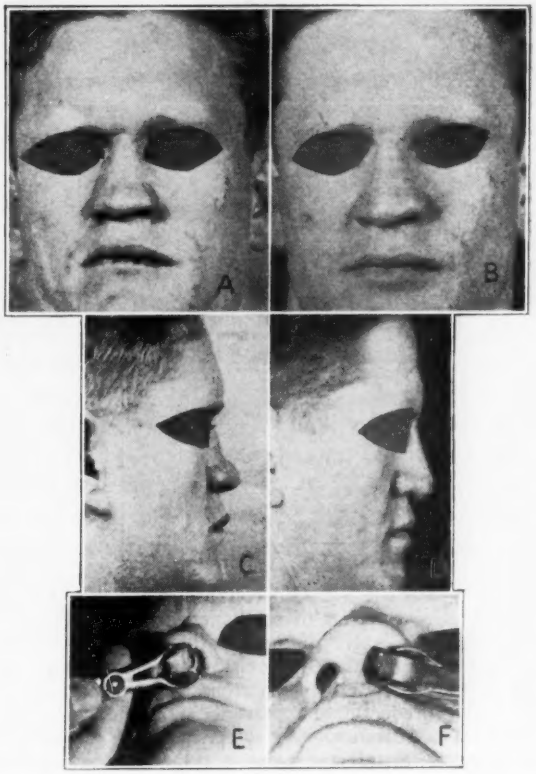


Fig. 6.—Patient H.: Crushing injury of the nose, with laceration which cut completely across the left naris and vestibule, occurring as a result of an injury while the patient was aboard ship. There is marked impairment of breathing from the crushed bony bridge as well as stenosis of the left naris by a constricting scar. *A*, front view—preoperative appearance. *B*, front view—postoperative appearance. *C*, side view—preoperative appearance. *D*, side view—postoperative appearance. *E*, inferior view—preoperative appearance, showing a stenotic scar. *F*, inferior view—postoperative appearance showing complete relief of stenosis by a free thick split graft applied to the vestibule.

6. Joseph, J.: Nasenplastik und sonstige Gesichts-astik, Leipzig, Curt Kabitzsch, 1931.

7. Safian, J.: Corrective Rhinoplastic Surgery, New ork, Paul B. Hoeber, Inc., 1935.

to the frontal bone are fractured manually and the deviation of the bridge corrected. Adjustments of the triangular and alar cartilages, as well as of the septal tip, may accompany the alteration of the bony bridge when these procedures are indicated.

If there is sufficient lateral deviation of the septum itself to maintain malposition of the bony bridge, lateral pressure splinting devices may be necessary to maintain correct position until such time as bony healing can occur and fix correct position for the septum. Such devices can be easily produced from stiff wire, with a plaster

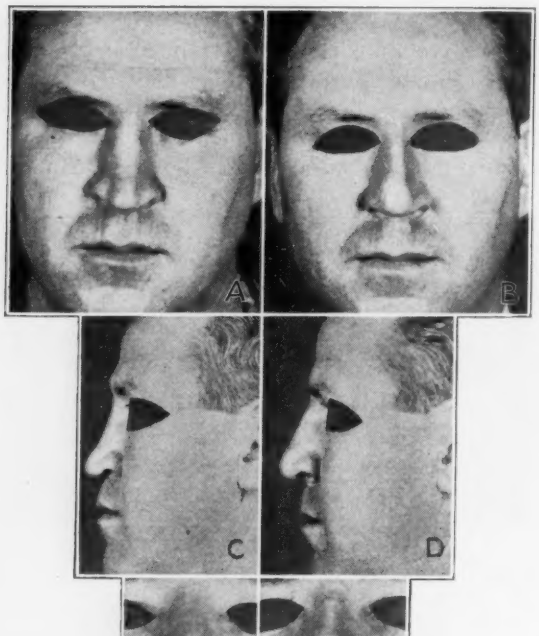


Fig. 7.—Patient S.: Old collapse of the nose following excessive removal of cartilage during a submucous resection. A "valve" effect of the collapsed tip obstructed breathing. *A*, front view—preoperative appearance. *B*, front view—postoperative appearance. *C*, side view—preoperative appearance. *D*, side view—postoperative appearance. *E*, inferior view—preoperative appearance. *F*, inferior view—postoperative appearance.

headcap used for fixation and a felt pressure pad against the nose. Flimsy patented devices attached to leather or metal headbands are, in my experience, ineffective unless constant mechanical vigilance over the contraption is maintained.

When cartilage grafts are utilized, the simplest dissection possible is performed in producing the pocket in which the graft is to lie. Incisions are made beneath the alar cartilages as be and are carried across the membranous sept Undermining and production of the pocket then performed, with care to lift a cuff of p osteum from the glabellar region to secure superior margin of the graft.

Huge grafts of cartilage can be placed thro intranasal incisions, and external disfigurem of the columella or the nasal tip is totally unnec sary. Autogenous cartilage is obtained by section of the seventh or eighth costal carti in its entirety. A piece of cartilage of any desi shape is then carved from this large source material. Fixation of the columellar post to bridge is more secure when a single right-ang piece is carved than when strut and bridge hinged or mortised together. Grafting of ca

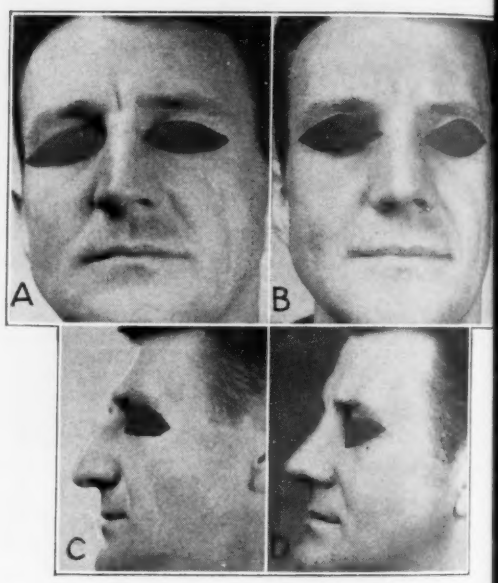


Fig. 8.—Patient K.: Congenital "humped" nose large proportions which caused extreme mental angu and neurotic "fixation." The patient was referred correction by the psychiatric department. *A*, front vi —preoperative appearance. *B*, front view—postop ative appearance. *C*, side view—preoperative appe ance. *D*, side view—postoperative appearance.

lage is rarely advisable at the time of other na skeletal corrections and should be perform later as a separate operation.

SUMMARY

Operations for correction of skeletal deform ties of the nose are indicated in military practi when the deformities have occurred as a resu of injury while the patient was on active du in military service or when a preexisting d formity constitutes a definite hazard to healt through obstruction or extreme neurosis.

TREATMENT OF ACUTE LARYNGOTRACHEOBRONCHITIS

HARRY L. BAUM, M.D.

DENVER

There are certain fundamental conceptions con-ing acute laryngotracheobronchitis which to mind should govern its management:

Until there is more precise scientific in-nation to the contrary, it appears to me to easonable to assume that this is not a specific ase entity but a clinical syndrome produced a combination of factors, certain of which man made.

I believe it to be primarily a virus infec-[1] probably influenzal, with secondary inva- by various pathogens, most frequently the ptococcus, as is common in all virus infec-s of the respiratory tract.

The most important pathologic change en-ntered in laryngotracheobronchitis is mucosal submucosal inflammatory edema in the larynx the lower respiratory tract.

Its most urgent early symptoms are those espiratory obstruction produced by the pres-e of edematous swelling in the subglottic ce.

Later symptoms of vast importance are se of respiratory obstruction from bronchial gging, which I believe to be one of the man-de factors with which one must deal, or, er, which one must, if possible, prevent.

With these quite elementary and partially theo-c conceptions in mind, the first point to be sidered in order of basic importance, though of urgency, is that of the treatment of the ction itself—the cause of the disease. Those o adhere to the theory that acute laryn-racheobronchitis is primarily caused by the ptococcus were naturally inclined to expect at things from the sulfonamide drugs, but in st instances experience has turned that hope disappointment. Graebner,[2] in a review of the records of the Willard Parker Hospital for the years 1937 to July 1, 1940, inclusive, offers the only really definite encouragement for the use of the sulfonamide drugs that I have so far encountered in the literature. Even his statistics, however, prove beyond doubt that these drugs are far from being specific in the treatment of acute laryngotracheobronchitis, although there is apparently no serious objection to their use for whatever value they may have. My own experience with them in this disease has been, without exception, unsatisfactory.

On the other hand, I have some hope for better results from penicillin, although it has as yet been available for only limited use. While it will probably not be of value against the primary invader if, as I believe, that is a virus, it may be used successfully to combat the secondary infection. My own experience has been limited to a single case, in which the tracheobronchitis failed to respond in the slightest degree to large doses of penicillin. Dawson and Hobby, however, in a recent paper on the clinical use of penicillin[3] included a case in which acute laryngotracheitis in an infant of 3 months required tracheotomy. In this case 600 units of penicillin in solution was injected intramuscularly every three hours and 1 cc. of a solution containing 250 units per cubic centimeter was instilled into the tracheotomy tube at three hour intervals. Recovery was rapid and uneventful. The positive and rapid action of penicillin on some of the secondary pathogens in laryngotracheobronchitis should be of at least some benefit in certain cases, such as those in which simple secondary suppurations of the mucous membranes supervene, some of those in which septic conditions arise, those in which the involvement is of the ulcerative bronchial type and those complicated by pneumonia.

Since there is available no commercial preparation specific for the primary infection in acute laryngotracheobronchitis, it is necessary to utilize the next best thing, and at present that is human

Read before the Section on Laryngology, Otology Rhinology at the Ninety-Fourth Annual Session he American Medical Association in Chicago, June 1944.

1. Baum, H. L.: Nonsurgical Aspects of Treatment Acute Laryngotracheobronchitis, Ann. Otol., Rhin. Laryng. **52**:608-619 (Sept.) 1943.

2. Graebner, H.: Chemotherapy in Acute Nondiphtitic Laryngotracheobronchitis, Arch. Otolaryng. **35**: 529 (April) 1942.

3. Dawson, M. H., and Hobby, G. L.: The Clinical Use of Penicillin: Observations in One Hundred Cases, J. A. M. A. **124**:611-622 (March 4) 1944.

immune serum. Thomas Francis Jr.,[4] Francis and Magill [5] and others have amply demonstrated experimentally that in both animals and human beings circulating antibodies to viruses causing epidemics develop, which antibodies can be utilized by transfer to raise the titer of immunizing substances in the blood stream of a recipient. It therefore seems to me logical that otolaryngologists should avail themselves of the possibility of treating laryngotracheobronchitis specifically with human immune influenza serum.[1] It is often feasible to secure blood from a contiguous donor (frequently a member of the patient's family) who has recently recovered from presumably the same epidemic respiratory infection from which primarily the patient with laryngotracheobronchitis is suffering. If this proves to be not practical, it is almost always possible to obtain blood from some one in the community who has recently recovered from what is probably the same infection or to obtain pooled human immune influenza serum from a bank maintained by otolaryngologists themselves or by a hospital in the community. As a substitute, and often as an adjunct, pooled human antistreptococcic (scarlatinal) serum should be administered because of the frequency with which the streptococcus is found as a secondary invader in these patients and also because most adult human serum contains a certain amount of influenza antibodies, the titer often being especially high during and soon after an epidemic of influenza. It is a simple matter to separate the serum, after which a dose of 50 to 200 cc. may be administered, depending on the size of the patient and other factors. It is preferably given intravenously, although either the intramuscular or the subcutaneous route may be chosen. Little improvement is to be expected during the first twenty-four hours, but after that time a steady and gratifying subsidence of all symptoms may be noted, and it is likely to continue, especially if an adequate supplemental dosage is supplied. Further details of the preparation and the administration of human immune serum have been covered in other papers.[6] Transfusions of immune blood may, of course, be used as a substitute wh available.

Of much more immediate urgency usua than attempted curative treatment of either primary or the secondary infections in these ca is the management of the respiratory obstruct and its sequelae. Subglottic laryngeal edema the early cause of respiratory obstruction, and is at this point that the endoscopist should by means enter the picture if he has not done earlier. Since I first advocated the use of h man convalescent serum and hypertonic plas I have been astounded to find that some phy cians have proceeded to undertake the mana ment of such obstructions without aid from endoscopist. Even though they have repor successes, sometimes most enthusiastically, that situation prevails I shall feel that my su gestions will in the long run result in more ha than good. Unless the physician in charge any patient with acute laryngotracheobronchi is a competent peroral endoscopist, the patien being denied the skilled attention this condit demands. But there is another side to the p ture. As specialists otolaryngologists undou edly have a tendency toward too great relian on mechanical means—too ready application their surgical skill. They are apt to forget t the mere performance of a simple operation su as tracheotomy is often only the beginning trouble, even though it does solve the immedi problem of respiratory obstruction. One still a serious infection to deal with, which combi with the sequelae of surgical intervention may tax the limit of one's ingenuity.

So first, before embarking on a considerat of those types of surgical intervention wh may eventually prove to be imperative for the lief of the respiratory obstruction, let the o laryngologist examine other possibilities wit the field. If the patient when first presented suffering from a grade of laryngeal obstructi which demands prompt relief, it is a mistake assume immediately that the only means of taining that relief is tracheotomy. That, I thi most often describes the mental process and consequent procedure. I believe that a somew less precipitate course will in certain instan pay excellent dividends. In every case the fi step should be preliminary laryngoscopy with anesthesia. It takes no longer to prepare direct laryngoscopy than for tracheotomy, and not constantly ready, both sets of instruments c as well be made ready simultaneously. It w be objected that the introduction of the laryng scope will create spasm and may precipitate crisis, but such has not been my experien Anything introduced into the larynx creates te

4. Francis, T., Jr.: Immunological Relationships of Strains of Filtrable Virus Recovered from Cases of Human Influenza, Proc. Soc. Exper. Biol. & Med. **32**:1172-1175 (April) 1935.

5. Francis, T., Jr., and Magill, T. P.: Immunological Studies with the Virus of Influenza, J. Exper. Med. **62**:505-516 (Oct.) 1935.

6. Baum, H. L.: A Method of Specific Treatment in Certain Streptococcic Infections, Arch. Otolaryng. **20**:504-513 (Oct.) 1934; Further Observations on the Use of Specific Immune Serums in the Treatment of Streptococcic Infections, Ann. Otol., Rhin. & Laryng. **45**:969 (Dec.) 1936.

y spasm, of course, but that is never worse e case of laryngotracheobronchitis than it is y other disease in which direct laryngoscopy t be required, and is often not as bad. After ction of the parts and aspiration or removal y secretion or false membrane which may be nt in the pharynx, the larynx or the sub- c space, the patient's respirations may be eably less labored, and it is possible that tions from the trachea may begin to appear een the cords if, as is sometimes the case, neffectuality of expulsive efforts due to sub- c swelling has resulted in their accumulation e trachea. This may occur to the point of st filling the tracheobroncial tree and may t disastrously, not infrequently being the of the most urgent emergencies among cases. If such a situation is suspected, it be easily relieved temporarily by carefully uating the aspirating tip between the cords into the trachea, even advancing it into the main bronchus for a short distance, and ving the accumulated secretions by means termittent suction.

may, of course, become necessary at any ent during these manipulations to pass the choscope for immediate respiratory relief, may seem desirable to do so for inspection e lower air passages or for more complete ation. Here gentleness of manipulation ot be too strongly emphasized. Every choscopist knows that traumatic subglottic a may supervene after the use of too large be or as a result of rough manipulation, in a normal larynx. Hence, no unusual rs of deduction are required to conclude that most meticulous care should be exercised in ntralaryngeal procedure under circumstances fection and inflammation such as that now r consideration. One of the primary requi- is a suitably small bronchoscope. For this ose I can imagine nothing more perfect than described by Jesberg,[7] the larger of which, still providing a working lumen of 4 mm., its outside diameter reduced to 6.5 by 5.5 compared with the outside diameter of 8 5 mm. of the standard Jackson 4 mm. choscope. For infants and the newborn Jes- has designed a special 3 mm. instrument a proportionate reduction in the outside eter.

e preliminary steps just described seem hy but actually they take but a few minutes, ng which the operator is always in complete mand of the situation, with quick and easy means of emergency relief from dangerous obstruction readily at hand in the form of the bronchoscope, through which oxygen may be conveniently administered. The introduction of a tube is a matter of seconds, and this type of temporary intubation can be easily utilized until the measure soon to be described can be prepared for, if needed.

It is possible that an adequate natural airway has now been restored, but that is by no means certain, nor is it certain that it will be anything more than temporary. It is therefore wise to consider a further nonsurgical step to combat the subglottic edema, as well as the edema which is frequently present throughout the mucosa and submucosa of the entire tracheobronchial tree where it often also produces serious complications. The step to which I refer is the intravenous administration of hypertonic human plasma (four times concentrated), which, I hasten to add, is not intended to combat the infection but only to reduce the interstitial edema and thus relieve obstruction. This method of treatment has been described in more detail elsewhere.[8] It is not a panacea, and it will not be found to be effective in every case, but I believe that its use is fully justified by the frequently impressive results obtained and by the great saving of time and trouble, not to mention lives, which success with it will accomplish.

Venesection seems to be a logical preliminary to the administration of concentrated plasma, particularly if circulatory embarrassment is apparent or if a large dose of plasma is to be used. Blood letting may be of itself slightly beneficial in certain of these cases, as it tends to reduce edema and even inflammatory swelling, but the chief consideration is that the administration of concentrated plasma draws fluid from the tissues into the blood stream. Thus, to facilitate this withdrawal and to avoid congestion, it seems desirable to remove a compensating amount of blood before the plasma is introduced. This procedure should not be invariably followed, especially with small children, as the clinical condition of the patient must govern above all else, but it is something to be considered.

While the patient is undergoing preliminary laryngoscopy, the four times concentrated plasma can be prepared. This is done by taking a standard desiccated plasma unit and, instead of restoring the plasma to the full volume of 250 cc., using a smaller amount of water, usually

Jesberg, S.: Two Baby Bronchoscopes — Esoscopes — Bronchoscopic Face Mask, Tr. Am. cho-Esoph. A., 1940, pp. 15-17.

8. Baum, H. L.: Acute Laryngotracheobronchitis: Treatment of the Obstructive Laryngeal and Tracheobronchial Edema with Hypertonic Human Plasma; Preliminary Report, Laryngoscope **53**:371-376 (June) 1943.

about 60 cc. Sometimes it is difficult to restore the dried plasma sufficiently with such a small amount of water. Considerable agitation is necessary, in spite of which the mixture may contain a few unrestored flocculi. If it is desired to expedite matters, as much as 80 cc. of water may be used, resulting in a solution of three times concentrated plasma, which is still effective. Furthermore, some form of filtration is desirable.[9] It should be emphasized that the plasma is not to be introduced into the vein by the drip method, however, but with a syringe by means of a three way stopcock. The syringe is attached to the stopcock and the latter to the outlet of the filtration device by means of a rubber tube. The filtration device is laid flat, and its inlet is connected by means of another piece of rubber tubing with the flask of plasma solution. No saline solution is used to displace the air in the apparatus, as dilution of the plasma with watery fluid would defeat the object of the procedure, but the plasma is drawn into the apparatus by means of the syringe and air is expelled until the tubing and the syringe are filled with solution and cleared of air. The required amount of plasma is then introduced intravenously as rapidly as desired. The remainder of the plasma solution is saved for later use if needed. Incidentally, this same equipment is excellent for the administration of convalescent serums.

The dose of concentrated plasma is usually from 25 to 40 cc., although the entire amount is sometimes used for larger patients. Relief is immediate, as a rule, with improvement in the respiratory obstruction quickly apparent, followed by establishment of productive coughing with rapid expulsion of accumulated secretions from the bronchi. On the contrary, relief may be somewhat delayed, which is, I believe, sometimes due to exhaustion plus the obtundation or near absence of the cough reflex frequently encountered in these cases, which results in slower expulsion of tracheobronchial secretions. This is another argument for assistance by means of pharyngeal and translaryngeal suction as already described.

If the patient is now in a satisfactory condition, he should be returned to the oxygen tent or to his room and kept under constant supervision while one awaits the expected further early improvement and observes what later benefit convalescent serum, penicillin, sulfonamide drugs or nature may achieve. By establishing an improved airway without resort to tracheotomy, one has at least given [illegible] agencies a chance, and by maintaining the [illegible] tient in an oxygen tent one can possibly pro[illegible] the waiting period for twelve to twenty-[illegible] hours, at the end of which much fundam[illegible] improvement may have become apparent.

Too much cannot be said for the use of m[illegible] cool oxygen in these cases. It should be [illegible] first resort in every instance without excep[illegible] and should be continued until the patie[illegible] out of danger. Every patient with acute lary[illegible] tracheobronchitis is entitled to this life-sa[illegible] respite from the inevitable exhaustion of ev[illegible] slight, if continuous, struggle for air. It [illegible] often turn the balance in favor of the pa[illegible] and against tracheotomy by prolonging [illegible] period of laryngeal breathing until other [illegible] sures have had opportunity to make their ef[illegible] manifest.

Not by any means will it be found possib[illegible] avoid intubation or tracheotomy in every [illegible] Never must a state of progressive exhau[illegible] leading to respiratory shock be permitte[illegible] supervene, no matter what means needs t[illegible] utilized to provide adequate relief. If the [illegible] cedures described do not achieve the de[illegible] result, they must be abandoned. Their pur[illegible] is to lessen shock and reduce risk, not to [illegible] crease them, and if they fail it becomes m[illegible] a question of which later procedure is prefe[illegible] tracheotomy or intubation. The latter I con[illegible] to be safer, and the operation of choice, espe[illegible] early. The direct method is used.

Once intubation is done, the problem i[illegible] of feeding, which is done by gavage, thr[illegible] the nose; of maintenance of the lumen o[illegible] tube; of replacement of the tube if it is co[illegible] out and of cleaning out of the lower respir[illegible] tract when thick, tenacious secretions emb[illegible] respiration. These things may try one's pat[illegible] to the limit, and without doubt they explai[illegible] preference for tracheotomy on the part of m[illegible] They can be satisfactorily met only if the[illegible] present in the hospital at all times a trained[illegible] experienced medical personnel. However[illegible] the use of immune serum is successful, it[illegible] be but a short time until the period of emer[illegible] in a given case will have passed.

Tracheotomy, on the other hand, though[illegible] doubtedly preferable in many ways, has its [illegible] aches as well, and there is no greater one[illegible] the dire results of the drying effect of the [illegible] blast of air through the tracheal cannula. [illegible] a fact, amply supported by the literature, [illegible] this certainly predisposes to the formati[illegible] obstructive plugs of semidried secretion in[illegible] bronchi of the patient with acute laryngotra[illegible] bronchitis. And while thick, tenacious [illegible]

9. At the Children's Hospital, Denver, the Baxter Filterdrip (manufactured by Don Baxter, Inc.), with disposable nylon filters, is used for this purpose.

in the tracheobronchial tree are very characteristic of this disease, they are never as thick gluelike preceding tracheotomy as they are For that reason I have called this portion e symptom complex of acute laryngotracheobronchitis man made, unpleasant as is that ght. Also man made is the local reaction may supervene in the sensitive tracheobronchial mucous membranes from manipulation nd contact with instruments and suction ratus, from local medication and from irrigation with various solutions. It is a perfectly n tendency to want to do either too much o little, and while I certainly do not advocate ttle in the management of this disease, I am convinced that too much is as often a These infected membranes can hardly fail act unfavorably to instrumentation and certypes of medicaments, although they often to tolerate them surprisingly well. Nevertheless, one cannot exercise too much gentleness anipulations, or too much good judgment in easures which one prescribes.

cannot omit from brief mention certain other rtant dangers incidental to tracheotomy, ially in children. They include mediitis, extensive mediastinal emphysema and mothorax. These complications, especially tter two, have taken many lives. A further sition of the relative merits of tracheotomy intubation under various conditions will ow be attempted, as the subject has already covered in a former paper.[10]

ter tracheotomy, a competent nurse can the lumen of the tube clear, instil solutions ious types for bronchial lavage and aspirate same by means of a catheter introduced gh the tracheotomy tube. And I believe these measures of lavage and aspiration are ble within limitations, although I have not een able to decide that any solution I have is strikingly efficacious as a liquefier of the ally viscid secretions of this disease.

s it is true of administration of oxygen, so is it of atmospheric moisture that too much ot be said in favor of its use, especially after eotomy. I am convinced, however, that atient's comfort is often too much lost sight the use of the conventional croup tent. is so intent on raising the humidity that one ts the oppressive and debilitating effects gh temperature, and they are important. ems to me that the temperature in a humid sphere should never be higher than 70 F. general physical well-being of the patient is to be appropriately considered. Albers[11] recently described the use of a nebulizer to supercharge the respired air with a solution of one part propylene glycol to two parts water containing sulfathiazole in the concentration of 3 per cent, through which oxygen was passed at the rate of 4 liters per minute. This obviated the use of the tent, and the supercharging of the air with the "fine oxygenated mist" seemed to take the place of instillations into the tracheal cannula, while aspiration of the tracheal secretions was made easier. Davison[12] has demonstrated that a high relative humidity (up to 95 per cent) can be maintained in the oxygen tent with a temperature of 70 F. (an effective temperature of 60 F., which is entirely comfortable for the patient). At the same time the oxygen concentration in the tent can be maintained at 50 per cent with a flow rate of 8 liters per minute. This seems to me to be an ideal prescription, and, as Davison said, "the prescription can be filled if there is an oxygen tent with a humidifier available."

It is a short step from thickened, adherent secretions to the formation of bronchial plugs just below the bifurcation and later in the smaller bronchi and bronchioles. One must be constantly on the alert for evidence of obstruction in the main bronchi, because it is less frequently recognized and much more rapidly fatal than laryngeal obstruction. Bronchoscopic removal is essential, and it should be realized that after removal the plugs are almost certain to reform, often necessitating repeated bronchoscopic procedures. Accumulations in the smaller bronchi are, of course, not accessible to bronchoscopic removal.

In addition to respiration of moisture and instillations made into the trachea, with aspiration, there is one other measure which I have found to be of distinct value in the effort to combat the progressive dryness which results in plug formation. That is the combined use of intubation and tracheotomy, regardless of which measure may have been instituted first. This is accomplished by corking or temporarily removing the tracheotomy tube and permitting the patient to breathe through the intubation tube, and it is remarkable how much improvement in the refractory dryness will often result. I called attention to this procedure before the Section on

Baum, H. L.: Tracheotomy and Intubation, Ann. Rhin. & Laryng. **36**:472-476 (June) 1927.

11. Albers, G. D.: Use of a Nebulizer to Produce Oxygenated Vapor: Report of a Case of Acute Laryngotracheobronchitis, Proc. Staff Meet., Mayo Clin. **18**: 511-513 (Dec. 29) 1943.

12. Davison, F. W.: Some Observations on the Control of Temperature and Humidity in Oxygen Tents, Tr. Am. Broncho-Esoph. A., 1940, pp. 112-121.

Laryngology, Otology and Rhinology of the American Medical Association sixteen years ago,[13] detailing several cases in which it had been used, but up to now I have not heard of its having been tried by others. Nevertheless, I still consider it to be of value and believe it should be utilized, just as I believe that intubation should be tried before tracheotomy. I know intubation may not be always practical under existing circumstances, but ideally I still believe it to be the operation of choice even though it may need to be followed by tracheotomy later.

The principal criterion which has been accepted by most writers as establishing the diagnosis of acute laryngotracheobronchitis in contradistinction to simple acute laryngitis and tracheobronchitis has been essentially that of the severity of the disease. I have myself, from the beginning of this work, made it a rule not to include in this category cases in which the laryngeal obstruction was not severe enough to require tracheotomy or intubation for relief. And therefore it has been contended, with proper conservatism, that persons who recovered without tracheotomy and without evidence of bronchial obstruction suffered from conditions not justifiably diagnosed as acute laryngotracheobronchitis. In other words, if the mortality in a series of cases was much less than 50 per cent all were not true cases of acute laryngotracheobronchitis.

Such a dictum is in truth arbitrary. It is especially so if the contention that one is not dealing with a specific disease entity is admitted, a situation which makes a really scientific diagnosis in any given case indeed difficult. I therefore now believe that, while it would certainly be deceptive to include in one's statistics cases in which the involvement is simple and relatively benign, the dictum can and should be modified. And treatment should be based on the theory that laryngotracheobronchitis is only a symptom complex of differing degrees of severity, its causes variable and some of its most serious manifestations partly avoidable. This conception should encourage otolaryngologists to use their best endeavors to simplify management short of surgical intervention in every case of acute laryngotracheobronchitis, actual or potential. They may then discover that they can often avoid formidable secondary developments, so that they may never know just how serious their cases might have been. In the course of patient and painstaking conservatism one will frequently encounter a twenty-four hour period of anxiety, but if this period can be satisfactorily bridged, seriously threatening cases will be converted into simple ones. Not always, by any means, will be true, but it is often enough true to reward effort and to justify watchful waiting while ting on the anxious seat.

Bearing out this theory relative to the of acute laryngotracheobronchitis is the fact the literature presents a number of instance which the symptom complex of acute lary tracheobronchitis, including bronchial plug was encountered secondary to the remov foreign bodies, with subsequent tracheotom cases in which the condition was obviously infectious. Some of my own earliest repo cases were of this type, and I have encount similar ones from time to time since. Rec Gittins[14] called attention to a form of the ease which he terms "traumatic laryngotrac bronchitis" in which foreign bodies were found, though suspected to be involved, which seemed to present almost the classic s tom complex of acute laryngotracheobronch though of less severe type.

It should perhaps be emphasized that in s epidemics of virulent infection of the respira tract, and sometimes even sporadically, extre severe and usually rapidly fatal acute lary tracheobronchitis is encountered. In many c this syndrome yields to nothing, especially profoundly toxic and septic types and the p monic types though, as already stated, hop held for good results from the use of penic because these types are apparently largely terial—the secondary infection seems to be overwhelming one. And when the cond present is that of extensive pulmonary ed with partial filling of alveoli as well as of tracheobronchial tree, symptomatic relief promptly follow administration of hyperi plasma with translaryngeal aspiration. The cedure is at least worth trying.

I have not attempted to make the manage of this symptom complex appear simple or e because it is not. Neither have I attempte give statistics to prove one or another proce to be superior, because I believe conclusion drawn to be often erroneous. The factors of or epidemic virulence, patients' resistance and dividual technical skill and equipment are variable. Many problems are yet unsolved, advances have been made in the past two years, and I look forward to much greater in the future.

CONCLUSIONS

Acute laryngotracheobronchitis is not a spec disease entity but a clinical syndrome produ

13. Baum, H. L.: Acute Laryngotracheobronchitis, J. A. M. A. **91**:1047-1102 (Oct. 13) 1928.

14. Gittins, T. R.: Laryngotracheobronchitis in C dren, Arch. Otolaryng. **36**:491-498 (Oct.) 1942.

combination of factors, certain of which are made. It is probably primarily influenzal in in, with secondary invaders, most often the ptococci, entering the picture later to con- ute their share of the damage. The only highly tive specific treatment now available is that human convalescent serum, primarily antiin- nzal and secondarily antistreptococcic serum. h such serums the disease may be shortened the development of the later complications etimes avoided. Management of the subglottic ma becomes of first importance when swell- threatens the integrity of the airway. Intra- us use of concentrated human plasma may e this problem satisfactorily, enabling one to d tracheotomy. The osmotic action of the rtonic plasma protein withdraws the fluid dema from the interstitial tissue spaces of the subglottic space and the tracheobronchial mucosa into the blood stream. Successful management of laryngeal obstruction without tracheotomy also avoids those serious sequelae, progressive tracheobronchial dryness and subsequent formation of plugs, with obstruction, and is therefore greatly to be desired. In spite of all efforts to the contrary, intubation or tracheotomy may become necessary. Intubation is the operation of choice, especially early, and a combination of both intubation and tracheotomy may frequently be of advantage to minimize tracheobronchial dryness. Breathing of moist, cool oxygen at all times and high humidity of the respired air, especially following tracheotomy, are fundamental in the management of this disease.

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INFECTIONS IN THE NASAL ACCESSORY SINUSES AND THE EARS IN OLD AGE

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The society which fosters research to save human life cannot escape responsibility for the life thus extended. It is for science not only to add years to life, but more important, to add life to the years.[1]

Old age confronts society with unprecedented problems, since it is estimated, according to Cowdry,[2] that in 1980 the number of persons over 65 years of age will be 14.4 per cent of the total population, more than double that of today. Babbitt[3] stressed the increasing numbers comprising the aging group and urged that otolaryngologists unite in studying geriatrics because of its obvious practical and scientific importance.

As a result of the senescent changes in the body as a whole and the local changes in the nose, sinuses and ears, there is altered function, which explains the peculiar and ofttimes unusual manifestations of infections in the aged, so at variance with analogous infections in younger people. Piersol[4] emphasized that these modifications must be clearly understood and appreciated if symptoms and signs in the aged are to be evaluated properly.

SENESCENT CHANGES IN THE NOSE, NASAL ACCESSORY SINUSES AND EARS

The alterations of tissue in old age, termed by Karsner[5] involutional or retrogressive changes, must be differentiated from diseases which occur in old age. Many of the phenomena loo ascribed to wear and tear may be end res from deteriorative processes modified by in tion. Dublin[6] declared that in the future cl study will be given to the part played by in tious diseases in hastening the degenerative p esses associated with old age. In general, progressive changes with age not as yet sh to be due to specific diseases have been s marized by Carlson[7] as follows: "gradual sue desiccation; gradual retardation of cell d sion, capacity of cell growth and tissue rep gradual retardation in the rate of tissue oxi tion; cellular atrophy, degeneration, increa cell pigmentation and fatty infiltration; gra decrease in tissue elasticity and degenera changes in the elastic connective tissue. . . Although this by no means complete enumera of the structural and functional changes of age sounds formidable, one must bear in m that these changes come on most gradually by themselves rarely give rise to clinical m festations. Many of the structural and functi changes have been observed in the upper piratory tract.

Nose and Nasal Accessory Sinuses.—Acc ing to Malan,[8] there is atrophy especially the turbinates, which are pale, dry and scar crusted. The epithelium frequently shows s mous epithelial metaplasia, never as pronoun however, as in ozena. Hollander[9] found the chief alteration in the nasal mucosa in age is a decrease of the lymphoid tissue in subepithelial layer as well as about the gla The atrophy of the lymphoid tissue through the body in old age is significant because of part this tissue plays in the reticuloendoth system, which is one of the important barr against bacterial invaders of the body. Acc

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Read at the Seventeenth Graduate Fortnight of the New York Academy of Medicine, on Infections and Their Treatment, at the Home for Aged and Infirm Hebrews, New York City, Oct. 13, 1944.

1. Piersol, G. M., and Bortz, E. L.: The Aging Process: Medical-Social Problem, Ann. Int. Med. **12**: 964-977 (Jan.) 1939.

2. Cowdry, E. V.: Problems of Aging, ed. 2, Baltimore, Williams & Wilkins Company, 1942.

3. Babbitt, J. A.: Relation of Geriatrics to Otolaryngology, Ann. Otol., Rhin. & Laryng. **50**:1079-1090 (Dec.) 1941.

4. Piersol, G. M.: Medical Considerations of Geriatric Problems, Arch. Ophth. **29**:26-35 (Jan.) 1943.

5. Karsner, H. D.: Involutional Changes in the Cardiovascular System, in Symposium on Medical Problems of Old Age, Philadelphia, University of Pennsylvania Press, 1941.

6. Dublin, L. I.: Longevity in Retrospect and Prospect, in Cowdry,[2] ed. 1, 1939, chap. 6, pp. 91-

7. Carlson, A. J.: Older Worker, Hygeia **21**: 339 and 375-377 (May) 1943.

8. Malan, A.: Senescenza della vie aeree super Valsalva **12**:1-14 (Jan.) 1936.

9. Hollander, A. R.: Histopathology of the N Mucosa of Older Persons, Arch. Otolaryng. **40**:92- (Aug.) 1944.

to Malan, the submucosa of the turbinates s some alteration similar to the change in rplastic fibrous atrophy described by Citelli. ous tissue develops around the glandular ents, with resultant destruction and disap- ance of the mucous glands. The vessels also involved, and with advancement of the tic process there may be obliteration of the ls and vascular spaces.

he turbinated bone also undergoes atrophic ge. Blumenfeld [10] reported the case of an ear old woman who was found to have a raceous transformation of the outer bony of the maxillary sinus. Atrophic changes one can be correlated with skeletal changes where in the body in old age. There is monly thought to be a gradual atrophy of mucous membrane with a loss of ciliary tion, but it is frequently impossible to dis- ate the unfavorable effects of environmental itions. Smith [11] has demonstrated a pro- sive diminution in the olfactory cells of the l mucosa, the atrophy varying from 7.6 per in the 0 to 15 year group to 70.5 per cent he 76 to 91 year group. Todd [12] expressed opinion that age is expressed not merely in logic changes but rather through complex hemical modifications which are manifested decline in the immunity of tissues. Macklin Macklin [13] emphasized the need for the rate recording of normal histologic develop- t as well as the abnormal, and this at all , for only when this is done can a basis be vided for an appraisal of true senile changes.

ar.—Old age produces structural changes h are not confined to the internal ear, since tical involutional processes are found in the dle ear and adnexa. Modifications indepen- t of the cochlea are also present in the laby- hine capsule. It has been demonstrated that osseous tissue of the ear becomes more brittle advancing age. According to Guild,[14] there neral agreement that the most common lesion the inner ear in elderly people is simple phy, of greater or lesser degree, of the nerve end organ in the basal turn of the cochlea. tologically, these lesions are indistinguishable from those which at younger ages are attributed to the effects of toxins, hereditary factors or unexplained degeneration. Ferrari [15] found noticeable ossicular atrophy, particularly in the stapes. Rigidity of the interossicular joints with calcification in the articular cartilages, degeneration and atrophy of the muscles in the tympanic cavity also have been noted. Malan described arcus lipoideus, a lesion due to the deposition of cholesterol in the drum membrane. There have been no typical histologic differences noted in the vestibular structures in ears from old and from young people.

As significant as the tissue and cellular alterations resulting from senescence may be, there are in human beings many other factors which serve to depress the activity of all bodily processes, and almost by themselves these seem adequate to explain the high incidence of infection in the aged. Among these can be included arteriosclerosis, cardiac disease of many kinds, diabetes mellitus, nutritional disorders, specific local pathologic changes, accidents and the mental attitude of the aged patient.

Study of the aging mind reveals that impaired memory is the first change but is followed later by changes in powers of retention, learning and judgment. Cerebral arteriosclerosis aggravates the picture. In practice, occasionally even when the aged patient is surrounded by a solicitous, well meaning family, the physician may, at the first visit, find serious infections in a far advanced state. This delay is explainable in part by the feeling that all sickness in old age is inevitable or to be endured silently. At this point, the quotation of Forbus [16] seems appropriate, "Until we know better, age must be considered as a factor of importance in disease causation, but not as an immediate cause of disease, as it is sometimes said to be."

INFECTIONS OF THE NOSE AND NASAL ACCESSORY SINUSES IN THE AGED

The symptomatology, diagnosis and treatment of acute and of chronic sinusitis have been frequently described and need not be repeated. However, there are certain aspects of sinus infections in the aged which warrant interest. It has been said that the course of infections in the aged may be paradoxic; that is, they may be extremely severe and dangerous or exceedingly mild. Infections in the maxillary sinus are

. Blumenfeld, cited by Malan.[8]

. Smith, C. G.: Age Incidence of Atrophy of Ol- ory Nerves in Man: Contribution to Study of cess of Ageing, J. Comp. Neurol. **77**:589-595 (Dec.)

. Todd, T. W.: Skeleton and Locomotor System, Cowdry,[2] ed. 1, 1939, chap. 2, p. 280.

. Macklin, C. C., and Macklin, M. I.: Respiratory em, in Cowdry,[2] chap. 9, pp. 185-253.

. Guild, S. R.: The Ear, in Cowdry,[2] chap. 21, pp. 566.

15. Ferrari, G., cited by Malan,[8] p. 7.

16. Forbus, W. D.: Reaction to Injury: Pathology for Students of Disease Based on Functional and Morphologic Responses of Tissues to Injurious Agents, Baltimore, Williams & Wilkins Company, 1943.

unlikely causes of intracranial complications. Suppuration involving the ethmoid and sphenoid sinuses, however, is not an uncommon cause of meningitis, especially when the type III pneumococcus is the etiologic organism.

Trauma to the frontal region in the aged, even of the most insignificant nature, has been reported as a cause of frontal sinus osteomyelitis, particularly when the trauma occurs in patients with chronic frontal sinusitis. Involvement of the frontal sinus may occasionally be complicated by abscess of the frontal lobe, particularly in the aged with neglected diabetes. It should be emphasized at this point that advanced age is of itself no contraindication for the employment of necessary operative procedures. Better anesthetics and better anesthetists and better preoperative and postoperative care make it possible for many older patients to have necessary operations.

Infections in the nasal accessory sinuses may frequently have profound constitutional effects in the aged. They may precipitate attacks of coronary thrombosis or bronchopneumonia or acute asthmatic seizures, or they may activate a latent bronchitis and at times be the predisposing cause of congestive heart failure. Zeman[17] analyzed 25 cases of bronchial asthma in persons varying from 60 to 79 years of age, in 10 of whom an antecedent acute infection of the upper respiratory tract initiated the sudden attack of asthma. In 13 of the 25 cases there was a coexistent bronchopneumonia. In this small, carefully studied group of cases, the importance of acute infection of the upper respiratory tract and sinus infection as precipitating factors in acute bronchial asthma, with or without bronchopneumonia, seemed striking.

Hansel,[18] in discussing indications for operations on the nose and nasal accessory sinuses in allergic persons, declared that each case presents an individual problem and that primarily methods of treatment for allergy must be instituted. The pathologic condition still remaining after appropriate treatment may require either conservative or radical treatment, depending on the clinical history, laboratory data, roentgen examination, cytologic and bacteriologic study of the nasal secretions and the age and general condition of the patient.

It has been pointed out time and again, particularly in the older literature, that latent infection in the nasal accessory sinuses may be the source of continued infection in the bron pulmonary tree. Anaerobic infection of the illary sinus following tooth extraction is uncommon and may be responsible for s toms referable to the bronchopulmonary Goodale,[19] in an analysis of 75 cases of bronc tasis in all age groups, definitely attributed pulmonary condition to a preceding infecti the upper respiratory tract in 32 cases. Kistn found sinusitis in all but 6 of 196 patients ages with chronic nontuberculous bronc Mullin [21] stated that patients with bronchitis to get well unless the condition is fostered fed by a chronic sinus infection. All too quently the commonly diagnosed "chronic b chitis" can be demonstrated by appropriate m ods to be a chronic bronchiectasis.

The association of sinus disease with b chiectasis was found in 66.8 per cent of 217 analyzed by Walsh and Meyer.[22] Adams Churchill [23] analyzed 712 case records at Massachusetts General Hospital and found associated sinusitis in 90 per cent of the c They stated that although the hypothesis sinusitis precedes and causes bronchiectasis been a popular one they had personally unable to subscribe to that view, except in sional instances. Graham [24] observed that sh after the onset of the sinusitis the bronc mucosa became inflamed.

On the other hand, Holinger [25] stated etiologic factors such as sinusitis, considere primary importance a few years ago, are regarded as only secondary, adding to the tensity of the disease rather than actually b important causes. Judging from my experi with the aged and from the available mat in the literature, I feel that infections in sinuses play a role in many, but not all,

17. Zeman, F. D.: Personal communication to the author.

18. Hansel, F. K.: Allergy of the Nose and Paranasal Sinuses, St. Louis, C. V. Mosby Company, 1936.

19. Goodale, R. L.: Analysis of Seventy-Five C of Bronchiectasis from the Viewpoint of Sinus Infec Ann. Otol., Rhin. & Laryng. **47**:347-349 (June)

20. Kistner, F. B.: Infections of Accessory Sinuses: Cause of Chronic Nontuberculous Bronc Northwest Med. **26**:203-207 (April) 1927.

21. Mullin, W. V.: The Accessory Sinuses a Etiologic Factor in Bronchiectasis, Ann. Otol., Rhi Laryng. **30**:683 (Sept.) 1921.

22. Walsh, T. W., and Meyer, O. O.: Coexisten Bronchiectasis and Sinusitis, Arch. Int. Med. **61**:89 (June) 1938.

23. Adams, R., and Churchill, E. D.: Situs Inver Sinusitis, Bronchiectasis: Report of Five Cases In ing Frequency Statistics, J. Thoracic Surg. **7**:20 (Dec.) 1937.

24. Graham, E. A.: Observations on Reaction Bronchial Mucosa Fistulae to Acute Infections of U Respiratory Tract, Am. J. Surg. **14**:382-383 (Oct.)

25. Holinger, P. H.: Bronchiectasis, Dis. of C **9**:1-4 (Jan.-Feb.) 1943.

ronchiectasis. I am in accord with the point of Clerf,[26] who stated that the prog- of bilateral bronchiectasis is always un- rable, irrespective of associated findings. ring of the nasal infection does not greatly ence the course of the bronchiectasis, except far as it may decrease the frequency of in- on of the upper respiratory tract and in way relieve the patient of a certain amount istress. What has been learned from the of bronchiectasis in all ages is directly icable to the problems presented by this dition in aged persons.

he relation between sinus disease and infec- arthritis has been the topic of much dis- ion. Boots and MacCollom[27] found that matoid arthritis was ushered in by an in- on of the upper respiratory tract in 20 per of their 180 cases. Seventeen per cent of patients had purulent sinus infections; in the r group, improvement usually occurred after uate treatment of the sinus infection. Wil- s and Slocumb,[28] in an unselected group of patients with infectious arthritis, found 20 clinically proved sinus disease. While these es are not of sinusitis in the aged, they nevertheless most interesting. Twelve of e patients were operated on, and the results not support the contention that sinusitis is principal focus in infectious arthritis. How- , the writers expressed the opinion that if s disease is present efforts should be made radicate it but that one must bear in mind that results of therapy are doubtful. Mosher,[29] iscussing unsolved problems in otolaryngol- stated, "The nose and throat as the source hronic systemic infection (focal infection, in r words) has been a great disappointment e in spite of radical operations at my hands t the hands of others." Mosher expressed oubt that more than 5 to 10 per cent of itic patients are cured by sinusotomies. Ex- ence with arthritis in the aged at the institu- with which I am associated indicates that the ority of the cases fall under the classification hronic osteoarthritis, designated osteoarthrop- by some, because it appears to be degenera- rather than infectious in origin.

Clerf, L. H.: Interrelationship of Sinus Disease Bronchiectasis with Special Reference to Prognosis, ngoscope **44**:568-571 (July) 1934.

Boots, R. H., and MacCollom, R. L., cited by roe, B. I.: Arthritis and Allied Conditions, Phila- hia, Lea & Febiger, 1944, p. 364.

Williams, H. L., and Slocumb, C. H.: Nasal essory Sinuses as Foci of Infection in Arthritis, Otolaryng. **29**:829-834 (May) 1934.

Mosher, H. P.: Unsolved Problems in Otolaryn- gy, Tr. Am. Acad. Ophth. **42**:27-47, 1937.

INFECTIONS IN THE EAR IN THE AGED

Suppurative Mastoiditis.—In a statistical study based on a review of 1,514 cases of acute suppurative otitis media, Maxwell and Brownell[30] found that only 26 of the patients were over 60 years of age. It is noteworthy, however, that surgical mastoiditis developed in 68.4 per cent of the 19 patients between 60 and 69 years of age and in 85.7 per cent of the 7 patients between 70 and 79 years of age. Forschner,[31] in a report on mastoidectomy in the aged based on a ten year review, found 392 cases of acute and chronic suppuration of the middle ear requiring mastoidectomy. Twenty-four (6 per cent) of the patients were between 60 and 79 years of age; 10 were over 70 years of age. Mayer,[32] in an analysis of 100 cases of acute surgical mastoiditis, reported that 5 patients were over 60 years of age. Farrior,[33] in an excellent report, analyzed mastoiditis in 36 patients over 60 years of age. Maybaum and Druss[34] reviewed 73 cases of mastoiditis due to the type III pneumococcus and found that 38 (52 per cent) occurred in the fifth, sixth and seventh decades of life. Altman and Waltner[35] reported 5 cases of mastoiditis due to the type III pneumococcus which were complicated by meningitis. Three of the patients were over 60 years of age.

Acute suppurative mastoiditis in the aged is frequently an insidious infecton, declared Farrior; the clinical manifestations are minimal, the complications frequent and the mortality rate high. The following report of a case demonstrates some of the aforementioned characteristics.

REPORT OF A CASE

A. S., aged 59, who had a history of an old coronary occlusion eight years before and who since had had attacks of paroxysmal fibrillation, was readmitted to the hospital with a history of a head cold and intermittent pain in the left ear of four weeks' duration. One week

30. Maxwell, J. H., and Brownell, D. H.: Suppurative Otitis Media: Statistical Study of 1,514 Cases, Ann. Otol., Rhin. & Laryng. **49**:973-990 (Dec.) 1940.

31. Forschner, L.: Klinische Erfahrungen bei Aufmeisselung des Warzenfortsatzes in höherem Lebensalter, Monatschr. f. Ohrenh. **71**:1220-1230 (Oct.) 1937.

32. Mayer, O.: Histologische und klinische Untersuchungen zur Ueberprüfung der Frage der Indikationsstellung bei der akuten Mastoiditis, Ztschr. f. Hals-, Nasen- u. Ohrenh. **17**:301-350 (Feb. 22) 1927.

33. Farrior, J. B.: Acute Suppurative Mastoiditis in Geriatrics, Laryngoscope **52**:688-696 (Sept.) 1942.

34. Maybaum, J. L., and Druss, J. G.: Otitic Infections Due to Pneumococcus Type III, Arch. Otolaryng. **30**:21-38 (July) 1939.

35. Altman, F., and Waltner, J. G.: Labyrinthitis Due to Pneumococcus Type III, Arch. Otolaryng. **40**: 75-91 (Aug.) 1944.

before his admission sedatives were required because of the pain in and around the left ear, especially at night. The day prior to admission, all pain had disappeared. There was no discharge from the ear at any time.

Results of examination were essentially normal except for the aural status. The right drum was resolved, and the landmarks were present, and the hearing was excellent. The left drum was full posterosuperiorly; radiating vessels were visible; there was no discharge, no sagging of the canal wall and no mastoid tenderness.

Roentgen examination of the mastoids revealed no definite evidence of destruction. The cells of the uninvolved right side were pneumatized and large. On the left side, they were also pneumatized but confined anterior to the sinus.

In the hospital, the patient was asymptomatic except for tinnitus in the left ear. Myringotomy was performed to determine the nature of the underlying infection. A small amount of thick pus was obtained. Culture of the pus revealed type III Pneumococcus. Eight days after the patient's admission the drum was unchanged; tinnitus persisted, and pain along the sternocleidomastoid muscle and tenderness of the tip developed. Operation was performed.

At operation, pus welled up from a perforation in the tip, accounting for the tenderness of the tip. The mastoid antrum, zygoma and periantral cells were sclerotic. The sinus plate looked necrotic and was removed. Pus oozed from the region about the bulb of the internal jugular vein. A huge perisinous abscess, with blackish necrotic-looking granulations extending on to the cerebellar dura, was exposed. The sinus, cerebellar and middle fossa dura were widely exposed to define healthy sinus and dura adjacent to the abscess.

The postoperative course was uneventful, the patient making a complete recovery. Chemotherapy was not employed either before or after operation.

Comment.—The obvious disproportion between the clinical signs and symptoms and the extensive disease found at operation should be emphasized. The patient never had a discharging ear, even after myringotomy. This masking of the symptoms is not uncommon in mastoiditis in the aged caused by type III Pneumococcus. The intermittent pain of which the patient complained had subsided, and only after eight days of observation did pain recur and mastoid tenderness become clinically demonstrable. Unilateral persistent tinnitus must be regarded as an important symptom in otitic infections in the aged, especially when its onset is concomitant with the onset of acute middle ear infections.

All of Farrior's patients had pneumatized mastoids and thick sclerotic cortexes. Roentgenograms are of considerable aid in diagnosis. Of 13 cases in which a positive culture from the mastoid was obtained, Farrior recovered type III Pneumococcus in 76.4 per cent of the cases. Pain, otorrhea, tenderness, changes in the canal wall, impaired hearing, fever, leukocytosis, the usual concomitant signs and symptoms of mastoiditis, may or may not be present in the aged. In the instances in which the type III pneumococcus is the infecting organism there may be none of the usual symptoms except perhaps tinnitus and a slightly reddened or thickened drum. In children these infections are not associated with the serious prognosis that they are in the aged.

In general, one can state that it is not definitely proved as yet that there is a decreased capacity in the aged for production of specific antibodies against infection. Even when one does not take into account the supposedly, but not proved, diminished immunologic responses of the aged patient as compared with those of the young, type III Pneumococcus must be considered a dangerous organism because of its insidious clinical characteristics: for example, absence of pain, fever, or significant changes in the middle ear in the presence of widespread destruction of pneumatized bone. Patients affected by this organism not infrequently have infection of long standing before they are seen by the otologist.

Sinus Thrombosis.—In order to emphasize the serious increase with advancing age in mortality from sinus thrombophlebitis the following tabulation is included, indicating the age distribution found in a recent analysis of 100 cases of sinus thrombophlebitis.

Age Distribution and Deaths from Lateral Sinus Thrombophlebitis

Age, Yr.	No. of Patients	No. of Deaths
¾ to 10	55	14
11 to 20	26	7
21 to 30	9	1
31 to 40	3	1
41 to 50	2	1
51 to 60	3	2
61 to 74	2	1

This table indicates the greater mortality after 30 years of age. Ninety of the 100 cases involved patients under 30 years of age, 20 of whom died; whereas of the 10 patients from 31 to 74 years of age 5 died. In order to illustrate a clinical picture which I have found to be characteristic in many ways of mastoiditis with complicating lateral sinus thrombosis in an aged diabetic, the following case is briefly outlined:

REPORT OF A CASE

A 63 year old woman with a severe diabetic condition was observed in the medical service, complaining of otalgia and headache of one week's duration. There was a spontaneous perforation of the drum, and the hearing was poor. The patient had chills, fever and drowsiness and vomiting. Culture of the discharge from the middle ear showed beta Streptococcus haemolyticus. The patient was seen by me, and a diagnosis of acute mastoiditis with lateral sinus thrombophlebitis was made.

Mastoidectomy was performed. There was widespread destruction of a type usually seen in type III pneumococcus infections. The lateral sinus was exposed and a necrotic sinus wall, with pus coming from the lumen, was found. The sinus was obliterated by an obturating infected thrombus; the diseased wall was excised.

necessary to follow the sinus back almost to the lar Herophili in an effort to get beyond the dis- wall. However, no free bleeding was obtained.

urse.—After the operation, the blood culture taken eratively was reported positive for type III Pneu- ccus. The patient was given chemotherapy and was ently doing well. The diabetes was under control; was out of bed walking about and had no head- On the twentieth postoperative day, she suddenly lained of headache; fever and signs of meningitis loped. Lumbar puncture revealed cloudy fluid con- ng gram-positive diplococci on smear. The distal f the lateral sinus was opened to the torcular Hero- but it was evident that I had not encompassed thrombophlebitic process. The jugular vein was ed. Following this operation the clinical course was ressively downhill, and the patient died two days

ecropsy.—The obliterating suppurative thrombo- bitis extended into the torcular Herophili and ugh to the opposite lateral sinus. The process also lved the straight sinus. There was a terminal sup- tive meningitis.

omment.—The clinical course after the original oper- n was most deceptive. The latent infection in the sed lateral sinus wall continued to spread without cal signs or symptoms. This hidden encroachment not uncommon characteristic of type III pneumo- us infections in diabetic patients. Chemotherapy may e in part tended to mask some of the signs and ptoms.

Diabetes mellitus in old age is relatively mild ically in the majority of cases except for complications, which are dangerous. The sence of diabetes in an old person necessitates at care once infection sets in, but, with reg- tion of diet and fluid intake together with ulin therapy, the internist is now able to ndle these ofttimes urgent situations with suc- s. Diabetes was present in 12 of the 73 cases mastoiditis due to the type III Pneumococcus orted by Maybaum and Druss.[34] They stated t the incidence of diabetes in infections of the due to Pneumococcus is definitely higher n in otitic infection due to other organisms. Inflammation of the middle ear leads more quently to complications when the resistance the tissues is impaired by uncontrolled dia- es, particularly in the aged. Involvement of soft parts is common, and there is an increased dency to bone destruction. Barth [36] reported cases involving diabetic persons with type III neumococcus in half the cases, a far higher per- ntage than in middle ear suppurations in non- abetic persons. Most of these cases involved tients between 40 and 70 years of age. All but of these patients underwent mastoidectomy, e indications for operation being the same for nondiabetic patients. Six of the 30 pa- nts died. Barth emphasized the frequent necessity for mastoidectomy in these persons, the great frequency of type III Pneumococcus infections and the high incidence of serious and fatal complications.

36. Barth, H.: Otitis media acuta und Diabetes, Klin. Wchnschr. **16**:198-201 (Feb. 6) 1937.

PROPHYLAXIS

What does this discussion of the serious infections of the nasal accessory sinuses and ears in the aged, with their attendant high morbidity and mortality, suggest? The virus-caused common cold, with its pus-forming secondary invaders, is the etiologic factor and results in complicating accessory sinus and otitic infections. Therefore, the cold in its inception must receive careful attention. I believe that by this approach one may hope to prevent and diminish the incidence of these potentially serious complications. At the Home for Aged and Infirm Hebrews, it is a routine procedure to isolate promptly persons suffering with a cold. Aqueous nasal sprays, steam inhalations, rest in bed and general supportive measures are employed. We believe the aged should be put to bed for the acute infections just as younger individuals should. This point has been stressed by many clinicians treating the aged. It is an old prejudice to keep old people out of bed as long as possible and, to quote "Müller-Deham,[37] "Many a crowned head has been forced to keep moving to prevent pneumonia, only to die sitting up in a chair." When old people are confined to bed, they should be turned frequently and given breathing exercises, taking care that the lower extremities are moved actively, or passively if necessary.

The patient should be cautioned against forceful blowing of the nose, particularly if there is nasal obstruction. Acute sinusitis is of fairly frequent occurrence during this period but fortunately subsides spontaneously in the majority of instances.

Good nursing care for the aged will frequently help in no small measure toward the subsidence of the acute infection of the upper respiratory tract without the development of a sinus or middle ear complication. In a certain percentage of cases, despite all precautionary measures, acute infection in the middle ear or severe sinus infection occurs. In this event, chemotherapy is promptly begun. Sulfadiazine is the drug of choice. It should be given in adequate dosage, and all the accepted precautions should be observed, particularly watching the drug level in urine in these aged patients, many of whom have known impaired renal function. One should not be deterred by the fear of masking,

37. Müller-Deham, A.: Die inneren Erkrankungen des Greisenalters, Vienna, Julius Springer, 1937.

but should bear in mind the altered signs and symptoms. Because of the consistently high incidence of cases of acute suppurative otitis media in the aged that have progressed to surgical mastoiditis with complications, it is our opinion that all should have an early and adequate course of chemotherapy. This should also be used in the severe cases of acute sinusitis, in order that the associated general complications in the aged may be forestalled. Good nursing care will lessen the incidence of complicating erysipelas and bed sores, which are common in persons of advanced years. Old people occasionally become careless about bodily cleanliness. Their skin, especially about the nose and auricle, becomes dry and atrophic. Minor cracks and bruises readily occur which are easily overlooked, with infection resulting. According to Boas,[38] in perhaps two thirds of all cases erysipelas begins on the face.

SUMMARY

Senescent changes in the body as a whole and locally in the nose, nasal accessory sinuses and ear are responsible for altered physiologic function. This explains the ofttimes unusual manifestations of infections in the aged, so at variance with analogous infections in younger people. These modifications must be clearly understood and appreciated if the clinical picture in the ag is to be evaluated properly.

Some general clinical features of access sinus disease and otitic infections in the ag have been observed. The obvious disproport between the minimal clinical signs and sympto and the extensive destruction found at operat in type III pneumococcus mastoiditis in the ag is worthy of emphasis.

In view of the high mortality of the com cations of acute infection of the upper resp tory tract in the aged, efforts should be direc toward prevention of involvement of the si and middle ear. Because of the consistently hi incidence of mastoiditis complicating ac middle ear suppuration in the aged, these p tients should have early and adequate che therapy. Chemotherapy should also be given cases of severe acute sinusitis in order to p vent initiation of complicating general disea such as coronary thrombosis, bronchopneumo and bronchial asthma with their attendant hi mortality rate.

There are many aged patients, stated Piers who have never learned to accept their advanci years gracefully and philosophically. Th attitude must be borne in mind when they co for treatment; and to obtain the best results, o must treat them with consideration, infinite p tience and gentleness.

38. Boas, E. P.: Treatment of the Patient Past Fifty, Chicago, The Year Book Publishers, Inc., 1941.

COMPARISON OF IMPROVEMENT IN HEARING FOLLOWING THE FENESTRATION OPERATION WITH THAT OBTAINED BY WEARING A HEARING AID

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CHICAGO

The Lempert fenestration operation is an ctive procedure which aims at a restoration of ring through reconstruction of a nonfunc- ning sound-conducting mechanism—aims at never attains perfectly normal hearing and y even result in a further loss in a case that most ideal for operation. In table 1 are the ults obtained in 321 consecutive operations h the fenestration technic that has been used past two and one-half years; this is the v-ovalis technic of Lempert modified by con- nt irrigation of the field and the use of the ocular dissecting microscope while the fistula being made.

Two years ago, before the American Otological Society, Dr. Gordon Berry presented "The Case for the Hearing Aid." He compared improvement in hearing obtained by the fenestration operation with the improvement possible with a well fitted hearing aid. He presented audiograms made in 13 selected cases, showing an over-all average gain of 43 decibels with a well fitted electrical hearing aid. The average gains after the fenestration operation as reported by Lempert, Campbell and Shambaugh were 24.3, 21.8 and 25.7 decibels, respectively. There was thus a ratio of approximately 23 to 43 between gain in hearing from fenestration and that from a well fitted hearing aid. Dr. Berry's conclusion was that a well fitted modern hearing aid can give greater amplification than the fenestration operation, to an acoustically wider group of patients and, in spite of the nuisance factor, at less cost in expense, in pain and in worry.

ABLE 1.—*Summary of Hearing Results After Six Months and After One Year in Three Hundred and Twenty-One Consecutive Cases in Which Fenestration Was Performed by the Nov-Ovalis Technic Modified by Constant Irrigation of the Field and the Use of the Operating Microscope*

				Hearing Still Improved			
	Hearing Worse	Hearing Unchanged	Hearing Improved, Then Lost	Gain of 10 to 19 db.	Gain of 20 to 29 db.	Gain of 30 db. +	Total Number with Improved Hearing
x months in 321 cases.....	7	16	15	64	117	101	282
	2%	5%	5%	20%	37%	31%	88%
e year in 201 cases.....	3	5	11	39	75	68	182
	1.5%	2.5%	5.5%	20%	37%	33.5%	90.5%

Average decibel gain in 282 ears improved after six months = +26.5
Average decibel gain in 182 ears improved after one year = +26.7
Average decibel gain in the ears not operated on in the 321 cases = +1

The patient in deciding whether or not to bmit himself to the fenestration operation with uncertain promise of imperfect results must st know that he satisfies certain rigid criteria hich make him a suitable candidate; second, should know the approximate chances of ccess or failure, as well as the discomforts d risks attending the operation; finally he must eigh these uncertainties and risks against the dvantages and the nuisance of a hearing aid. emember that those persons who are ideal bjects for the fenestration operation are pre- sely the ones who are most helped by a hearing id.

Two years ago, about the time that Dr. Berry presented his paper, the wife of an acoustical engineer underwent the fenestration operation. Two months later she wrote as follows:

> When I submitted to the fenestration operation in June 1942, I had absolutely no comprehension of what restored hearing would mean. Never once in my fifteen years of deafness had I imagined the joy of sounds normally heard. Whether this is unusual or not in deafened people I do not know, but surely it would

Read at the meeting of the American Laryngological, hinological and Otological Society, New York, June 9, 944.

have been silly to dwell too much on what was apparently out of reach. The ear phone I had worn since Christmas of 1937 seemed a fine thing. It was an instrument of good make, and my family and friends showed me much consideration in the using of it. I counted myself fortunate to have mastered the handicap so well, and was often complimented on the ease with which I carried on a conversation.

During the ten days in the hospital there was no improvement, and I dared not think of what the result might be. On the twelfth day, the bandages came off,

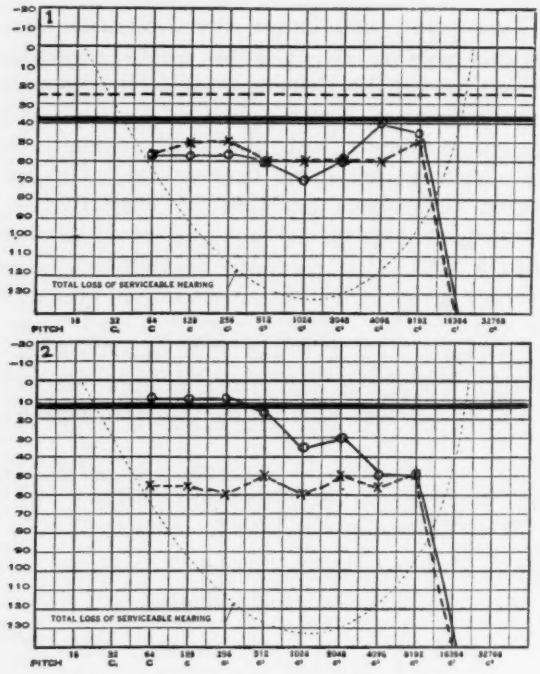

Chart 1.—Audiograms of Mrs. L. (table 3) (*1*) before and (*2*) ten weeks after fenestration of the right ear. Circles on curves represent hearing in the right ear; crosses, hearing in the left ear. In audiogram 1 the broken horizontal line represents the hearing level for speech with a hearing aid; the unbroken horizontal line, the level without the aid.

and a hearing test in the doctor's office showed an increase of 10 decibels of hearing. Then the fun began. I remember walking rather shakily downtown and being amazed at what a noisy village we lived in. Actually it is a quiet little four corners, but the extreme quiet I had known was not the true level. Hearing tremendous motors bearing down on me from behind, and finding them to be only innocent, ordinary autos; sitting quietly at a store counter and having conversation drift into my ear—I didn't mean to listen in, but the novelty of being caught up in the commonplace visiting of neighbors and acquaintances, even strangers, tied me up with the world I had lost; to be part of my own house once more, and be spoken to from room to room or up and down the stairs meant undescribable joy.

The next test in the doctor's office, nineteen days after the operation, showed a hearing gain of 33 decibels, which has remained in each successive test.

It had been so long since the piano had meant pleasure that sitting down to that instrument for the first time brought a real peak in the curve of happi I climbed. The richness of tone and the endur of sounds and musical colors I had completely f gotten. Playing the piano at first brought real p to the ear, and as a matter of fact, all sounds in t first two weeks seemed too loud. The quality of restored hearing is so natural that this pain pas away very soon indeed, however.

Appreciation of the reeducation in music that is op ing before me may be keener in the knowledge th I had taken a college degree in music in 1932. month following my graduation recital in piano, father of the surgeon who performed the fenestrat operation in 1942 gave me this verdict after exami tion of my ears: "You've got progressive otoscler and there is nothing to be done about it; so put on ear phone and make the best of it."

I certainly do not want to seem ungrateful for five years' excellent service the hearing aid gave m I hesitate to think what those years without its h might have been. But the point I do make is that t best ear phone is a poor substitute for normal hearin If this seems too obvious a statement, it is only that who have been through the looking glass of the d torted and undistorted reflection, can hardly believe ear, now that it has been given back to me.

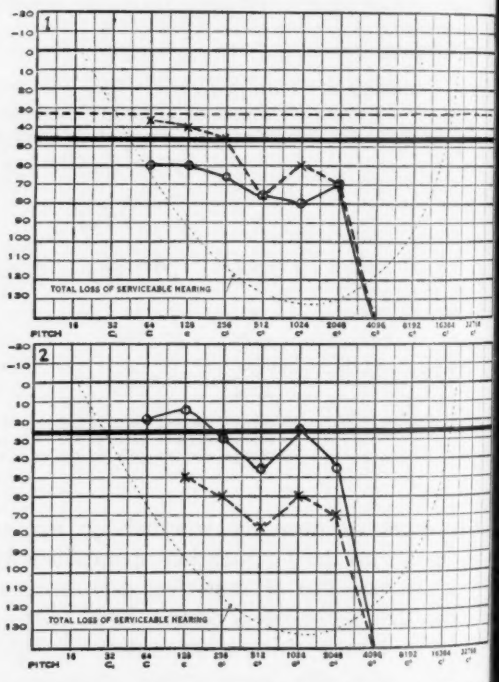

Chart 2.—Audiograms of Mr. J. (table 3) (*1*) bef and (*2*) one month after fenestration of the right e Circles represent hearing in the right ear; crosses, hea ing in the left ear. In audiogram 1 the broken ho zontal line represents the hearing level for speech wi a hearing aid; the unbroken horizontal line, the lev without the aid.

An audiogram of this patient's hearing seve months after operation shows a 36 decibel ga for the speech frequencies, bringing the hearin in the fenestrated ear to an average loss of 1 decibels for speech. I have not seen her mo

ently, but Dr. Lurie tells me that her hearing provement has been maintained.

A questionnaire was sent out to all of my pa- nts who had undergone the fenestration oper-

ABLE 2.—*Replies to Questionnaire from Patients Who Had Used a Hearing Aid Before Their Fenestration Operation*

Reply	Five Patients Who Received No Lasting Significant Improvement	Ninety-Five Patients Who Received Lasting Hearing Improvement: Gain of 10 to 19 Decibels (17 Patients)	Gain of 20 to 29 Decibels (36 Patients)	Gain of 30 or More Decibels (42 Patients)
nnot hear well as h the aid	2	1	1	0
n hear as ll as with e aid	1	4	3	3
n hear bet- r than with e aid	2	12	32	39

proof room the aid can be used at its maximum volume for threshold tests, with little interference from static, distortion and the disproportionate amplification of outside noises, which combine to interfere with the hearing of speech. However, one must also consider that the patient who has gone through the pain, expense and worry of an operation may try to justify the operation to himself by exaggerating its benefits.

The final answer to the important question of which gives the better hearing seemed to me to depend on a satisfactory method of measuring the hearing for speech rather than the hearing for pure tones in terms of decibels. Such an instrument, however, was not available. In talking with Dr. Scott Reger, of Iowa City, I expressed the need for such an instrument, and he promptly devised and constructed it for me. Dr. Reger's instrument consists of a phonograph attached to an amplifier, with an attenuator to regulate the intensity of the sound in decibels.

ABLE 3.—*Results of Tests of Hearing with the Reger Speech Audiometer Before and After Operation in Fourteen Cases in Which a Hearing Aid Had Been Used*

atient	Hearing Loss for Speech with the Speech Audiometer, Decibels: Before Operation Without Aid	Before Operation With Aid	After Operation Without Aid	Time After Operation	Hearing Loss for Frequencies of the Speech Range with the Pure Tone Audiometer, Decibels: Before Operation	After Operation	Gain or Loss, Decibels
rs. C.	52	44	40	4 mo.	85	48	+37
rs. R.	44	32	28	3 mo.	54	23	+31
rs. N.	50	28	22	6 mo.	61	31	+30
rs. G.	52	36	32	2 mo.	77	56	+21
r. J.	46	34	26	3 weeks	77	38	+39
r. S.	44	28	26	4 mo.	66	33	+31
rs. L.	38	24	12	5 weeks	65	26	+39
These 7 patients received an average or better than average improvement of hearing, i. e., a gain of 20 or more decibels with the pure tone audiometer, and in all of them the hearing for speech was as good or better than with their hearing aid							
r. H.	42	24	36	1 mo.	63	50	+13
rs. D.	54	26	40	3 mo.	62	41	+19
rs. J.	52	32	40	3 mo.	70	57	+13
rs. S.	48	28	32	1½ mo.	57	42	+15
iss F.	48	28	32	3 mo.	72	55	+17
These 5 patients received a less than average improvement, and their hearing for speech did not equal that with their hearing aid							
r. G.	38	16	34	5 mo.	47	56	— 9
r. L.	38	26	42	1½ mo.	64	79	—10
These 2 patients experienced a further loss with the pure tone audiometer. Since in their cases the ear with the poorer hearing had been operated on, their hearing for speech was only slightly changed by the operation							

tion, asking them to compare their hearing ince the operation with what they had experi- nced when wearing a hearing aid. The answers re set forth in table 2.

How can one reconcile the experience of these atients with Dr. Berry's statistics, which show greater gain from a hearing aid than from the peration? The explanation, I believe, is that he hearing aid shows to its best advantage hen tested with pure tones, for in a sound-

The patient sits at a measured distance from the amplifier. A phonograph record made on glass, played by a jeweled needle, speaks numbers which the patient is asked to repeat, the loudness being regulated until the threshold is found at which the patient can just hear and repeat correctly the numbers.

I have had the Reger speech audiometer for only six months, and since improvement in hearing often takes six months to reach its maxi-

mum after operation, I do not yet have final measurements on a large series of cases. The data on 14 patients who had worn hearing aids before operation and who were tested with the Reger speech audiometer before operation, with and without the aid, and following operation are in table 3.

SUMMARY

With a new type of audiometer, measuring the hearing for speech rather than that for pure tones, it has been found that patients who experience an average or greater than average hearing gain from the fenestration operation have as good or better hearing for speech than t formerly had from their hearing aid. Pati experiencing a less than average improve in hearing (a gain of less than 20 decibels) not hear as well as they did with a hearing

On the basis of the one year results obtai through application of the fenestration tec now employed, the prospective ideal subject the fenestration operation may be told that has approximately a 90 per cent chance o lasting improvement in hearing and appro mately a 70 per cent chance that the hear will equal or surpass that with a hearing

AEROSINUSITIS

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During the past year or more while working h aviation cadets from a nasal standpoint, we de a number of interesting observations re- ding nasal function with changing altitudes. First we shall review the literature to reveal accumulated thought on aerosinusitis, after ch our own experiences will be reviewed.

DEFINITION

Aerosinusitis is an acute or a chronic inflam- tion caused by trauma to the mucous mem- ne of a sinus. The trauma is brought about a difference between the air pressure within sinus and that of the surrounding atmosphere. is phenomenon occurs commonly during the nges in altitude in airplane flights and is aracterized by inflammation of the mucosa ing the sinuses and is accompanied by pain and comfort. These symptoms may vary with the us affected.

AEROSINUSITIS IN THE LITERATURE

In a review of the available literature on avia- n medicine, it is quite apparent that aero- usitis does not hold a prominent position. The ason for this is probably because the condition less frequent than aero-otitis media. The lat- r condition has received a good deal of at- ntion. Nevertheless, it has long been known at changes in atmospheric pressure during ght affect the sinuses. The field of aviation edicine is comparatively new, and the present ar has stimulated a greater interest in these nditions than ever before. The phenomena countered on flying are many and varied. omplications affecting the upper respiratory stem are but a small part of the problem at nd. Nevertheless, aerosinusitis in present day ying is a serious and fairly common problem. It has been stated that "one of the most mis- derstood problems in the entire field of edicine, by both physician and layman alike, that of the paranasal sinus." [1] As far back as 892, Black [2] observed that changes in altitude, even though these changes took place slowly, af- fected the nasal mucosa and the sinuses. He noted that people coming from the sea coast to Colorado nearly always contracted the "worst cold they had had in years." This observation was not followed up, and it was not until after the advent of the airplane that interest was re- vived in the subject.

Armstrong,[3] in his textbook on aviation medi- cine, mentioned the importance of a clear nasal passage in aviators which allows air to enter and leave the sinus cavities with changes of altitude. He also noted that changes in temperature and pressure can produce congestion of the nasal mucous membrane. Simpson [4] pointed out that septal deflections are more liable to cause trouble in aviators than in persons who remain on the ground. Whaley [5] stated that unless the septum practically obstructs one nostril it is not neces- sary to remedy it. Pittman [6] stressed the im- portance of seeking out nasal abnormalities in candidates for flying. Among conditions men- tioned are deflection of the septum, allergic re- actions of the mucosa, polyposis, tumor about the nose and acute and chronic inflammation and vasomotor rhinitis. He stated that sinuses are much less often affected in flight than is the middle ear, because the sinuses are connected to the nasal passage by shorter and more widely patent openings than is the eustachian tube to the ear. Smith [7] maintained that a normal naso- pharynx is essential and that any obstruction or acute or chronic sinus disease is indeed harmful

1. Bullwinkel, H. G.: The Nasal Accessory Sinuses nd Aviation Medicine, Mil. Surgeon **91**:522-528, 1942.
2. Black, G. M.: The Effect of Altitude upon the ucous Membrane of the Upper Air Passages, with eport of Cases, New York M. J. **55**:407-408, 1892.

3. Armstrong, H. G.: Principles and Practice of Aviation Medicine, Baltimore, Williams & Wilkins Company, 1939.

4. Simpson, J. D.: Medicine of Flying, J. Roy. Nav. M. Serv. **27**:249-258, 1941.

5. Whaley, J. B.: Problems of Aviation Medicine Relating to Ear, Nose and Throat, Arch. Otolaryng. **36**:438-442 (Sept.) 1942.

6. Pittman, C. D.: The Middle Ear and Accessory Nasal Sinuses from a Flight Surgeon's Point of View, Ann. Otol., Rhin. & Laryng. **50**:518-522, 1941.

7. Smith, A. C.: Medical Aspects of Aviation, Arch. Otolaryng. **23**:139-148 (Feb.) 1936.

in altitude flying. Kafka [8] warned the family physician to have corrected in all candidates for flying such findings as nasal polyps, sinus infection, hypertrophied tonsils, a badly deflected septum or any general inflammation about the mouth or the throat. Fenton [9] rejected for flying those who had nasal pathologic conditions as outlined but expressed the opinion that seasonal allergy is not a contraindication to high altitude flying. Chester and Drooker [10] stated:

> In our experience aero-sinusitis is not very common, nor is it a major problem with army flyers. Probably the reason is that in the course of clinical examination, the appearance of the internal nose as compared with the ear, is a more obvious indication of the condition of the sinuses. Polypoid changes and suppurative conditions increasing nasal resistance to air flow are more obvious than functional changes which take place in the Eustachian tubes when stress is placed upon them.

Predisposing Causes of Aerosinusitis.—There is agreement in the literature that there are predisposing factors in aerosinusitis as well as in acute sinusitis. Bullwinkel [1] expressed the belief that repeated attacks of colds impair ciliary function and result in thickened edematous tissue throughout the nose and the sinuses. Other predisposing factors to be considered are an excessive use of tobacco or of alcoholic beverages, low basal metabolic rate, fatigue, sexual excesses and constipation. Campbell [11] and Crosson and his associates [12] agreed that any one with chronic sinusitis should not fly, as the symptoms of such a person are nearly always exaggerated. Fatigue in aviators is stressed by Fenton,[9] Behnke and Willmon,[13] Kafka,[8] Armstrong [3] and others as predisposing to infection of the upper respiratory tract. Such fatigue might wel sinusitis of a low grade sypmtomless type will flare into acute aerosinusitis when expected.

Physical Factors Involved.—In order t derstand the problem of aerosinusitis, certai tors must be briefly reviewed. Airplanes climb as fast as 5,000 feet (1,500 meters minute and may descend at a rate of 40,00 (12,200 meters) per minute. A man in a chute may drop as fast as 10,000 feet (meters) per minute before opening his The ordinary airliner descends at about 40 (122 meters) per minute. It is therefor parent that the rate of change of atmosp pressure is a great deal more rapid in planes than in commercial ones.[11a] It is erally agreed that rapid change of pressu responsible for complications arising in sinuses.

The percentage composition of air re approximately the same at all altitudes, the partial pressure of oxygen and of nitr decreases as the altitude increases. Hen volume of air at sea level gradually expand altitude is increased and will occupy about times its former space at 33,700 feet (10 meters). If an open receptacle such as a p nasal sinus is subjected to a rise in altitude contained air expands and will leave the c by way of the normal ostium. On descent will enter the sinus. If the ostium of the s is immersed in fluid, such as pus, air will bu from the cavity on ascent. On descent the f will be forced into the cavity. Campbell [11] estimated that on descent from 18,000 feet 485 meters) such a cavity may be half filled fluid. The fluid remains within the cavity u ciliary action and gravity remove it. If opening of a sinus is partially obstructed i without by a polyp or by redundant tissue, can escape on ascent, but on descent the tis may be dragged into the ostium as air atte to reenter the sinus. This ball-valve action p vents air from entering the sinus and a rela vacuum is created. It is generally accepted t this vacuum within a sinus is responsible for production of aerosinusitis. Campbell [11] poin out that the symptoms will continue until pressure within the sinus becomes equal to t of the outside atmosphere. It is supposed t while the vacuum exists there is a cupping act on the mucosa of the sinus which brings ab dilation of the blood vessels, edema and pr ably exudation of fluid. Gradually the ede and the fluid take up space in the sinus and t pressure becomes equalized. This is the

8. Kafka, M.: The Flying Cadet and the Family Physician, J. A. M. A. **116**:956-957 (March 8) 1941.

9. Fenton, R.: Otolaryngologic Aspects of Commercial Aviation, Ann. Otol., Rhin. & Laryng. **40**: 1070-1075, 1931.

10. Chester, L., and Drooker, J. C.: Aero-Otitis Media and Aerosinusitis, Laryngoscope **53**:203-209, 1943.

11. Campbell, P. A.: (*a*) Aerosinusitis, Arch. Otolaryng. **35**:107-114 (Jan.) 1942; (*b*) Aerosinusitis, in Bothman, L., and others: The 1941 Year Book of Eye, Ear, Nose and Throat, Chicago, The Year Book Publishers, Inc., 1941, p. 355.

12. Crosson, J. W.; Jones, R. R., and Sayers, R. R.: Helium-Oxygen Mixtures for Alleviation of Tubal and Sinus Block in Compressed Air Workers, Pub. Health Rep. **55**:1487-1496, 1940.

13. Behnke, A. R.: High Atmospheric Pressure: Physiological Effects of Increased and Decreased Pressure; Application of These Findings to Clinical Medicine, Ann. Int. Med. **13**:2217-2228, 1940. Behnke, A. R., and Willmon, T. L.: Physiological Effects of High Altitude, U. S. Nav. M. Bull. **39**:163-178, 1941.

space-filling mechanism mentioned by bell.[11] Should the ball-valve be produced undant tissue from within the sinus, then cent the air in the sinus is unable to make it by way of the ostium. This causes ve pressure within the sinus and is thought the reason for symptoms of aerosinusitis ing on ascent. Proetz,[14] however, has d that distention of the mucosa of a sinus does not cause pain.

is agreed by most writers that difficulty is encountered in the sinuses during rapid es of pressure as long as the ostiums are and as long as there is no fluid, pus or dant tissue which could obstruct them. on, Jones and Sayers,[12] in a survey made ompressed air workers, came to the con- n, as did Campbell,[11] that sudden rapid es in pressure are usually the immediate of developing symptoms. The former ob- rs, however, expressed the belief that as shes into a sinus through a relatively small ng, it can easily cause puckering of an ad- g boggy nasal mucosa. If this process is d far enough, such tissue might be dragged the ostium of the sinus and cause a valve- block. As the negative pressure is rapid xtreme even in a more or less normal nose, possible to produce aerosinusitis. This on is not held by Campbell[11] or Behnke Willmon.[13] However, after observing many e patients, it does seem that in a few at least ross symptoms and findings of aerosinusitis op when little is to be found in the way of xisting nasal pathologic change.

SYMPTOMS

he symptoms of aerosinusitis are few. There ways acute pain localized to one of the sinus s, more commonly the frontal region. After lization of pressure, there may be stuffiness hat side of the nose as the pain subsides. patient may blow blood from the nasal pas- of the affected side, or the blood may appear e nasopharynx and the sputum. In all cases aerosinusitis and accompanying symptoms directly proportional to the rapidity of the ge in pressure on ascent or more commonly escent. Pain usually clears on equalization ressure whether this is effected by shrinkage he tissue about the ostium or by the "space- g mechanism" of the lining mucosa.

hysical Explanation of the Resulting Patho- Changes.—Campbell[11] Behnke and Will-[13] Pittman[6] and others[15] have agreed that in acute aerosinusitis there is always marked congestion of the mucous membrane of the involved sinus. The blood vessels are engorged, and there is edema, probably with exudation of fluid into the cavity. Behnke and Willmon[13] stated that this engorgement takes place only when the ostium of the sinus is occluded and that it may occur with only slight changes in pressure. On the other hand, normal sinuses with open ostiums can withstand sudden changes of pressure from 240 pounds to 3 pounds per square inch (16 Kg. to 200 Gm. per square centimeter). This change is equivalent to a sudden rise to 38,000 feet (11,580 meters). He explanied this mechanism of engorgement in aerosinusitis as follows: The ostium of the sinus is blocked, and therefore the tension of gases in the lining cells remains constantly at equilibrium with the air in the cavity. However, the tension of gases in the circulating blood and the body mass increases on descent. This, said Behnke and Willmon,[13] tends to put pressure on the cells of the lining membrane and serves to dilate the blood vessels in the tissue lining the occluded space. This in turn causes the lining membrane to be sucked off the underlying bone and evaginated into the space of lower air pressure. It would seem more likely that in an attempt to establish a gaseous equilibrium between the cells of the affected sinus membrane and the rest of the body, the blood vessels dilate to allow a more rapid interchange of gases and to effect more rapidly a state of equilibrium. This dilation of vessels not only brings about interchange of gases but, as elsewhere in the body, is accompanied by edema of the tissues. This reaction is more pronounced when the change of altitude is rapid and when the difference in pressure is great. The process may become so extreme as to cause seepage of fluid into the cavity and may cause rupture of a blood vessel with bleeding into the tissue or the sinus proper. This explanation may apply also to those fewer cases in which symptoms of aerosinusitis develop on ascent. Here, if the ostium is occluded, the contained gases are under greater tension than those of the outside atmosphere and those of the blood and the body mass. There is rapid dilation of the blood vessels in order to bring about a rapid equalizing of the tension in the cells lining the sinus to that in the circulating blood and the rest of the body. This is necessary to allow more rapid interchange of gases.

Proetz, A. W.: Practical Management of Head- Ann. Otol., Rhin. & Laryng. **52**:409-418, 1943.

(*a*) Gurkov, A. D.: Significance of Nasal Sinuses athogenesis of Headache During Training in the Barometric Chamber and During High Altitude Flights, Med. zhur. **11**:305, 1941; cited by Salinger, S.: Paranasal Sinuses, Arch. Otolaryng. **36**:249-250 (Aug.) 1942. (*b*) Hermann, A.: Laceration of the Mucous Membrane and Hematoma of the Nasal Sinuses in Aviators, Ztschr. f. Hals-, Nasen- u. Ohrenh. **47**:103, 1940; abstracted, Arch. Otolaryng. **37**:739 (May) 1943.

Unfortunately, the dilated vessels set up edema of the tissue with the sequelae mentioned. Thus the same process appears to be possible whether there is negative or positive pressure in the sinus. In the majority of cases by far it occurs with negative pressure in rapid descent from high altitudes.

Sequelae.—Recovery was the rule in the cases of aerosinusitis seen by Campbell.[11] There was seldom any residual infection other than localized catarrhal sinusitis of short duration. However, this localized condition does lower the resistance to subsequent infection, and in the presence of virulent organisms it is not uncommon for severe purulent sinusitis to develop. Hermann [15b] reported laceration of the sinus mucous membrane with separation from the underlying bone and the development of submucous hematoma. This condition was shown in 2 cases at operation.

Experimental Work.—It is universally believed that aerosinusitis is accompanied by acute traumatic inflammation of the mucous membrane. Most observers, however, feel that this can come about only if the ostium of the sinus is obstructed in some manner during a sudden change in atmospheric pressure. Of significance here is the experimental work of Gurkov.[15a] He used a water manometer to record the pressure within the frontal sinuses of cats under various conditions. At rest there was a rhythmic fall and rise of the pressure corresponding to inspiration and expiration. When there was partial stenosis of the nares, the pressure within the sinuses rose to about six times normal. As the pressure was slowly decreased in the pressure chamber, over a period of thirty to forty minues, the pressure in the sinuses remained positive until an altitude of 19,500 to 25,000 feet (5,945 to 7,620 meters) was obtained. Here it began to drop, becoming negative at 32,800 feet (10,000 meters). On descent the pressure within the sinus remained as low as 5 to 30 mm. of water until ground level was reached. Here it slowly returned to normal. The lining mucosa was found to be extremely hyperemic after sudden ascent or descent. The experiments were carried out with animals under narcosis. This experiment tends to show that negative pressure can be established within a sinus without blockage of its ostium through nasal pathologic changes. It also shows that a sudden decrease in atmospheric pressure causes marked engorgement in the vessels in the lining of the sinus. Therefore, it seems likely that in rapid change in altitude, engorgement of the tissue does occur but that only in some cases does the process become so marked as to cause symptoms.

Pain is the chief subjective symptom in ac sinusitis. It is reasonable to associate pain w inflammation. Behnke and Willmon [13] expres the belief that the pain is due to the congest of the tissue lining the sinus. Campbell [11] s that the tissue may be torn in the vacuum est lished and thus cause pain. Crosson and as ciates [12] expressed the opinion that pain is t result of the distention of the blood vess According to Simpson,[4] the pain originates the mucosa or in the bony wall of the sinus. has never been conclusively proved just wh the pain originates and what mechanism sets off. Suffice it to say that it occurs follow acute inflammation of the mucosa and originat in the walls of blood vessels, the inflamed tissu or the periosteum.

It is obvious that much is yet to be learn about acute aerosinusitis. Careful observati of the effect of sudden changes in atmospher pressure may add much to the understanding the physiology and the pathology of the pa nasal sinuses whether these observations occ in flight, in the altitude chamber or on t ground. We have observed a considerable num ber of cases following flights in the low pressu chamber.

OUR OBSERVATIONS CONCERNING AEROSINUSIT AT AN ARMY AIR BASE

The low pressure chamber can simulate a altitude and any rate of ascent or descent. Th it can produce the barometric changes whi are experienced in actual flight. It does n duplicate the cold present at high altitudes, whi may have an influence on the nose. Neither do it cover the terrain as an airplane does. Th a pilot in actual flight may start in a war country and land in very cold surroundings, a of which may have an influence on the nas mechanism. These factors have been advanc in criticism of the low pressure chamber as means for the study of medical aviation problem but these criticisms are not wholly justified the principal cause of aerosinusitis is changi barometric pressure, and the low pressure cha ber duplicates the changing pressure very w and under absolute control. Naturally, it do not give any indication of how a specific nas apparatus will react to changing climate, whi may be important at times.

The altitudes and the rates of climb will b mentioned in connection with the cases di cussed.

Low Pressure Chamber as a Test of Nas Function.—On physical examination a gre number of patients in our series were found n to have sinusitis and were passed for flying, b

lated flight in the low pressure chamber uced sinus pain. This led to the diagnosis of d degrees of pathologic change. The ne flight offers an additional means of nasal nination and often brings to light conditions found by other examinations. It is logical, efore, that flight should constitute an impor- part of the physical examination.

requency of Aerosinusitis.—This condition ot nearly as common as aero-otitis media. this army air base, observation on a year nd basis and covering thousands of flights he low pressure chamber has revealed that sinusitis occurred in 1.6 per cent of persons e aero-otitis media occurred in almost 6 per . We have never seen any figures for actual g, but we believe they would be about the e.

Material or Types of Cases to Be Presented.— o types of patients were studied: (1) those eriencing aerosinusitis in the low pressure mber as well as some who experienced it in al flight; (2) patients seen with nasal patho- c changes of moderate to marked extent who no difficulty in repeated simulated or actual hts. Both groups were investigated by visual mination, by study of roentgenograms, by gations and in many cases at operation, at ich time the pathologic alterations could be quately seen.

Etiology.—Changes in barometric pressure are immediate cause of aerosinusitis. Obstruct- pathologic tissue is the underlying or pre- posing cause in that it prohibits free passage ir to or from the sinuses. Aerosinusitis can- develop without both these factors being sent. The degree or the rate of change in ometric pressure is of utmost importance in production of symptoms. A slow change l often give air of different densities oppor- ity to equalize through even a restricted sinus ning. A rapid change of pressure may force undant tissue into the openings so quickly and ld up differential pressure so rapidly that no ation is possible. Symptoms of pain and ssure will occur rapidly in such a case.

The reason for the almost universal absence pain or other disagreeable symptoms on ascent interesting. It has often been stated in the rature on aero-otitis media that the construc- n of the eustachian tube accounts for the lack pain in the ear or of development of aero-otitis dia. This is true but it does not tell the entire ry. The sinuses have no such "flutter valve" chanism but only simple ostiums. The role ascent and descent in the two conditions, areo- tis and aerosinusitis, is the same. The struc- ture of the eustachian tube, however, does account for the preponderance of aural symptoms over sinus symptoms on descent. At this field there was approximately five times as much aero-otitis media as there was aerosinusitis. We believe that this would be the experience in any type of flying.

Symptoms.—As mentioned previously, the symptoms occur chiefly, if not almost entirely, on descent.

The onset may occur almost immediately on descending or more frequently after descending several thousand feet. The majority of the symptoms have come on in the region of 16,000 feet (2,400 meters) when 28,000 feet (8,500 meters) was being used as the upper level of flight in tests in the low pressure chamber. Because of the greater density as sea level is approached, many symptoms develop during the last few thousand feet.

Pain is the outstanding symptom. It is almost always in the area of the frontal sinus. Occasionally it is over the maxillary sinus. The preponderance of pathologic alterations which are thought to be responsible for pain in the region of the frontal sinus are in the antrum. The pain may be intense or slight. Some statements as to intensity are of interest. Patients stated that the pain was "like a tetanus shot," "like sticking an ice pick into the sinus" "like being hit on the head with a crowbar," "felt like the whole head was going to explode" and "felt like my eye was going to pop out." Much of the pain is of minor intensity, however, and does not cause any serious difficulty. All pilots were asked if the pain interfered seriously with landing. Most stated that it did not. Many complained of lacrimation on the same side as the pain, and this often complicated flying by interfering with vision. At times there was a discharge of blood or serous fluid from a ruptured cyst, but this was not common. As mentioned later in case histories, numbness in the upper teeth and the face over the distribution of the infraorbital nerve is rather typical of an accumulation of blood in the maxillary sinus. Bleeding into the sinuses, however, has not occurred in a large number of cases.

As to duration, pain for the most part is present only for a short time, usually disappearing in a few minutes to several hours after descent if not before. The pain and the discomfort in the cases of hemorrhage are of longer duration.

A symptom occasionally mentioned, though not necessarily a painful one, is a hissing or bubbling of air from the upper nasal passages on ascent. This is due to the passage of air from a sinus now the site of increased pressure.

If this air did not escape, there would result a pain in the sinus such as is sometimes complained of on ascent.

Predisposing Pathologic Conditions; Factors Responsible for the Development of Aerosinusitis.—By far the greatest number of persons experiencing aerosinusitis attribute the difficulty to the common cold. As is well known the term "cold" may cover a recent infection or sinusitis of a month's standing or more. Allergic states may also complicate the picture.

Statistically, in thousands of cases as many as 40 per cent of the men undergoing routine flights had nasopharyngitis, yet only 1.5 per cent experienced aerosinusitis. Although infections of the upper respiratory tract are responsible for most of the aerosinusitis, this condition nevertheless occurs in a small proportion of these infections.

The preponderance of the sinusitis is maxillary. Some is frontal and little is sphenoid. The ethmoid sinuses are frequently involved, but demonstrating such an involvement as the cause in the presence of maxillary sinusitis is difficult. Occasionally the ethmoid sinuses are involved alone in the predisposing pathologic condition.

Deviation of the nasal septum alone has not often been found to be the cause of symptoms. Early in the investigation 100 persons with the most markedly deviated septums who came to us for submucous resection were sent on a flight in the low pressure chamber. None experienced difficulty. We have seen only a few cases in which the deviation of the septum was thought to be responsible for the production of symptoms. In these cases no pathologic involvement of sinuses was demonstrated. Straightening of the deviation, which was high, seemed to correct the condition, and flying was accomplished without further trouble.

We should state here that evaluation of a pathologic process as the cause of the symptoms and the apparent relief from the correction of it is rather difficult. Aerosinusitis may occur only periodically and may be relieved by such simple methods as shrinking. Those cases in which the patient experiencing continuous trouble on descent was relieved and remained so after some corrective procedure are much more definite. Several such cases will be reported as representative of various types of pathologic change.

In general it may be stated that in the vast majority of cases of aerosinusitis the correlative pathologic alteration will be found on the side of the symptoms and that corrective procedures will restore function so that no further trouble will be experienced. Acute conditions need little in the way of corrective measures. Irregularities of the septum can be successfully c rected. Antrums which cannot be cleared washing will withstand rapid changes of b metric pressure if treated by any proce furnishing an intranasal opening. Frontal si sitis is more difficult to relieve but often respo to time and conservative treatment.

Several general classifications are offered i which cases of aerosinusitis fall from a sympto atologic-pathologic point of view.

1. Acute rhinitis: Acute cold of short duration previous history of sinusitis; pus in the middle me or the meatuses; nasal congestion. Sometimes th is roentgen evidence of cloudiness of the sinuses the side of the symptoms or sometimes on both s to the same degree with symptoms only on one s

2. Beginning chronic sinusitis: Nasal discharge stuffiness of several months' standing following acute attack; roentgen evidence of sinus disease, usu antral, of the same side as the symptoms; occlu of a sinus opening as determined by difficulty in ir gation of the sinus. There may be isolated pathol changes in the antrum.

3. Central frontal pain: Pathologic change is fo on both sides, in the antrums usually, or a ma septal deviation or thickening high up.

4. Marked deviation of the nasal septum to one s with no evidence of sinus disease. Pain on the of the deviation.

5. Pus in the middle meatus on the side of the sy toms but with a comparatively normal roentgenogr Undoubtedly a variety of views of the sinuses wi show some pathologic condition of the ethmoid la rinth.

6. Little if any pathologic change to account for symptoms.

7. Chronic sinusitis with or without polyp formati Symptoms on the side of the lesion. Often polypo a polyp is found in the nose on the same side in middle meatus.

8. Allergic rhinitis with swelling of the nasal muc membrane and sinus mucosa of hyperplastic charac

Roentgen Findings in General.—The roentg reports frequently direct attention to a hazin of many sinuses or an opacity of one or bo antrums with clouding of other sinuses. Usua there is pain only on one side, and one sinus responsible. This inability to focus roentg ographically on any one sinus as the site o pathologic process makes statistical analy nearly impossible. The following case illustra the point in question:

A roentgen report was made on an aviation ca D. S. B., Oct. 21, 1942, as follows: There is a thi ening of about 3 mm. of the mucosa lining the r antrum, and polyps are seen both at the roof and the inferomedian walls of this sinus. There is a mild mucosal thickening of about 1 mm. in the antrum. There is hazy clouding in the frontal sin due to mucosal thickening. Mild mucosal thicken is also seen in the sphenoid sinuses.

This patient suffered repeated pain in the gion of the right frontal sinus on descent. I

on of the right antrum built up marked antral ssure repeatedly. Intranasal opening of the t antrum entirely relieved the inability to ergo changes in altitude. The nose showed hing other than a small polyp in the right dle meatus. With a complete picture from visual examination, the irrigation of the an- and the roentgen study, no difficulty is d in correlating the pathologic changes re- nsible, but the roentgen observations alone are her inconclusive, though leaning toward the ected sinus. At times the roentgenogram is only means of detecting the pathologic con- on involved.

n aviation cadet, C. R. D., suffered a severe pain the right eye on descent. He said, "The right was blacked out." He complained of no real cold. hing pertinent was seen in the nose. The middle tus was well open, and there was no pus. After history and the physical examination had given tive results, an additional flight was made without ble. When the roentgen report was returned, it wed complete opacity of the right antrum.

Occasionally various abormalities are found, h as a septal deviation or a pathologic change the antrums. Each could be the causative dition, or both might be responsible.

Physical Effects of Change in Barometric ssure.—The most marked physical effect on sinuses produced by change in barometric ssure was observed in the case of J. A. M., aviation cadet. The history is as follows:

n Aug. 30, 1943 he entered the hospital. Seven s previously he was on a routine flight in the low ssure chamber to 38,000 feet (11,580 meters) for the time of three hours. There was no difficulty on ascent while at this altitude. On descent, at about 10,000 (305 meters) he experienced a severe pain in the ble left side of his face. The following day he was pitalized in a medical ward, where he complained pain and numbness on the left side of his face. On second day there was a discharge of blood from left nostril. The blood was old and dark. After few days he showed some improvement and was missed. On the same date he returned to the hos- l because the pain and numbness had become inten- ed. He was seen for the first time in the ward for ients with diseases of the nose and throat. He com- ined of pain on the left side of his face and of nbness on the left, including the lower eyelid, the e, the upper teeth and the upper lip. Its distribu- n was that typical of the infraorbital nerve. There s tenderness over the left antrum. There was little rth noting in the nose other than mild congestion. roentgenogram of the sinuses showed opacity of the antrum, but little else (fig. 1). On two occasions gation of the left antrum was attempted, but noth- could be forced through. A considerable pressure s built up, which intensified the pain.

ive days after his entry the left antrum was opened ause of the continuance of the rather severe pain discomfort and the failure of other means to relieve pain. The Caldwell-Luc procedure was carried . The periosteum of the canine fossa was somewhat nd down by fibrous reaction. The bone was thin and easily removed. When the sinus was opened a bluish membrane bulged out under pressure. Incision of the membrane revealed the cavity filled with many blood clots enclosed in membranous sacs and none free in the antral cavity. There was no space in the antrum which was not filled by these rounded enclosed clots of old blood. There was a dark red color to all the structures. No blood could be evacuated without incising the membrane covering the clot. The entire membrane with the clots was removed, and an intranasal opening was made. Microscopic examination showed the bleeding to have taken place in the subepithelial tissues of the mucous membrane (fig. 2). It seems justified to assume that the hemorrhage in the submucosa was caused by relative negative pressure which pulled the mucosal layers apart, thus rupturing the blood vessels. This is exactly what happens to the layers of the drum membrane in aero-otitis media with resulting hemorrhage between the layers.

There was an uneventful recovery, with relief of the symptoms.

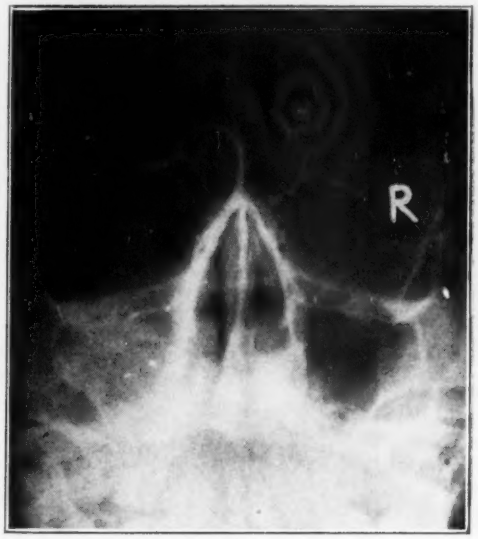

Fig. 1.—Roentgenogram showing opacity of the left antrum of J. A. M.

This case is not presented as representative of the usual findings in aerosinusitis. It is an extreme case which vividly brings out the mechanism involved and the pathologic changes in severe aerosinusitis. The same pathologic process was observed in other cases but to a much less degree.

In another case of aerosinusitis the antrum was opened for other reasons and an interesting end result of a train of pathologic events was observed.

On June 23, 1943, R. D. G. went on a routine flight to 38,000 feet. He experienced pain in the region of the right frontal sinus on ascent (this being extremely unusual). After twenty-seven minutes at 38,000 feet he could stand it no longer and was brought down. On examination immediately after the descent, there was blood in the right nostril, and blood was washed from the right antrum. There was tenderness over the region of the right frontal sinus. Two more antral irrigations were done at three day intervals with re-

moval of some old blood clots and finally a slight amount of pus. He could not carry on with school and was hospitalized on July 15, three weeks after the flight. With hot compresses and nasal shrinking his disease cleared up rapidly. The first roentgenogram was taken ten days after the flight and showed opacity of the right antrum and a small round shadow in the left frontal sinus (fig. 3 *A*). By August 23 the right antrum had cleared with the exception of two rounded shadows, one at the floor and one at the roof of the maxillary sinus (fig. 3 *B*). Because of the disqualifying nature of this pathologic picture, the antrum was opened with the patient under local anesthesia. Only one rounded swelling was found, the superior swelling. It ruptured easily, discharging a small amount of old liquid blood. The rounded mass seen on the floo the roentgenogram had been absorbed. One week intervened between the roentgen examination and operation. The remaining membrane was normal. recovery was entirely uneventful.

The opacity of the antrum probably re sented a collection of blood with some engorgem With some clearing, the subepithelial hemorrhage peared like a polyp or a cyst. These are freque seen here and are disqualifying. It seems certain th in another week or so both of the rounded mas would have been absorbed.

Another case is that of aviation cadet G. W. whose roentgenogram showed bleeding into the su mucosa with opacity of the right frontal sinus and

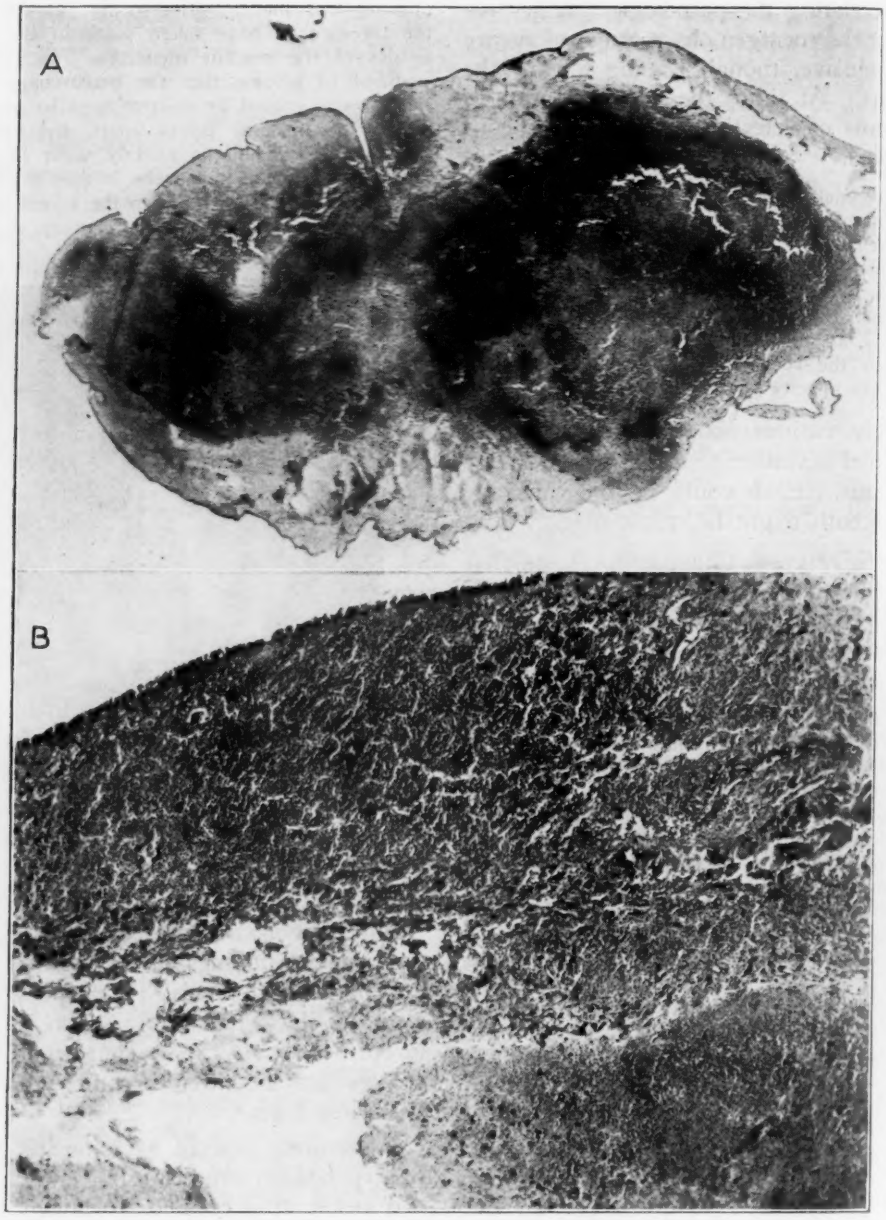

Fig. 2.—*A*, magnification × 10. A massive hemorrhage is seen in the subepithelial tissue lining the antr shown in figure 1. The epithelium encloses almost the entire section. The base is to the right. *B*, magnifi tion × 100. The hemorrhage extends through the mucosa from the subepithelium to the basal layer of t epithelium.

rum (fig. 4). There was no difficulty on ascent or at 00 feet. On descent there was almost immediately in the region of the right frontal sinus. The pain sharp but not unbearable. Several days later he was pitalized because of continuation of the headache in area of the right frontal sinus. There was dis- rge of old blood from the right nostril. The left tril was entirely normal. The right antrum was hed, with return of old blood and relief of pain. recovery was uneventful, with no further treat- nt. One month after the flight the roentgenogram clear.

and then the same pain was felt in the region of the left frontal sinus. There was only a slight cold at the time of the flight. No blood came from the nose at any time. Examination shortly after the last flight showed an essentially normal nose. The series of roentgenograms (fig. 5) is especially interesting. They show that at first there was a rounded shadow in the frontal sinus on one side. A few days later there appeared a rounded shadow in the frontal sinus on the other side, exactly opposite the first and of about the same size. Following this, there was gradual clearing by absorption. These shadows are taken to represent

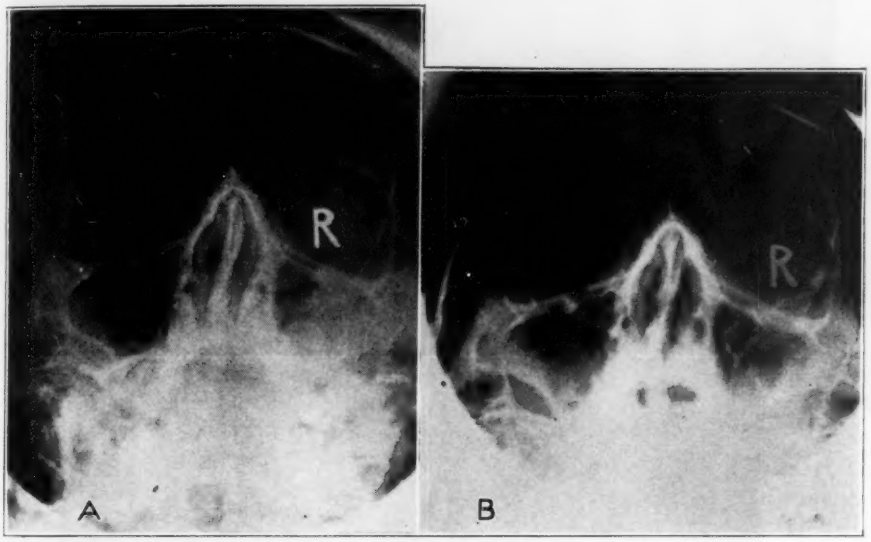

Fig. 3.—*A*, opacity of the right antrum of R. D. G. *B*, clearing of the right antrum. Two round shadows still visible.

Fig. 4.—Opacity of the right antrum and frontal us of G. W. N.

An interesting case in which there was bleeding into e mucosa of the frontal sinus is that of Lt. E. S. n a routine actual flight he experienced a sharp pain the region of the left frontal sinus during descent. The in lasted only until ground level. The following y the same sequence of events took place. The pain as in the same region and of about the same intensity. he descents were both at about 3,000 feet (915 meters) minute. Following this, there was one clear flight, submucosal or mucosal hematomas. The one on the opposite side can be explained only by assuming that there was a bony dehiscence which allowed the bleeding to travel through the frontal septum. The rounded shadows absorbed with no treatment whatever.

Purulent Sinusitis Produced by Changes in Barometric Pressure.—It has often been stated that in cases of respiratory infection the negative pressure produced within a sinus on descent may aspirate purulent material from the nose and thus produce purulent sinusitis. This seems a likely mechanism, and we cannot refute the statement. We do feel, however, that purulent aerosinusitis is uncommon. A purulent antrum is usually found when the physician searches for the cause of aerosinusitis immediately after the flight. This is too soon for the development of purulence which is the cause of the symptoms and not the result of any aspirating effect. Most patients state that the sinusitis was present prior to the flight and was not made worse by it. We have seen 1 patient who gave a history of severe pain during a descent and of trephining of the frontal sinus on the following day for relief of symptoms of acute sinusitis. The pathogenesis is not known, as the patient was not seen by us until some time later.

Summary of the Physical Effects Occurring with Aerosinusitis.—As illustrated by the cases presented, injury to the mucosa occurs as a result of changes in barometric pressure which cannot be equalized, resulting in marked pathologic changes in some cases. These conditions, if not too severe, have a great tendency to heal by absorption without treatment.

As to the literature on the physical effects of aerosinusitis, Hermann [15b] reported partial detachment of the mucosa with hematoma in the frontal and maxillary sinuses of flyers. [illegible] occurred during great changes in barometric pressure. He stated that this caused the appearance of the hematoma between the bone and the detached mucosa. We take it that any [illegible]

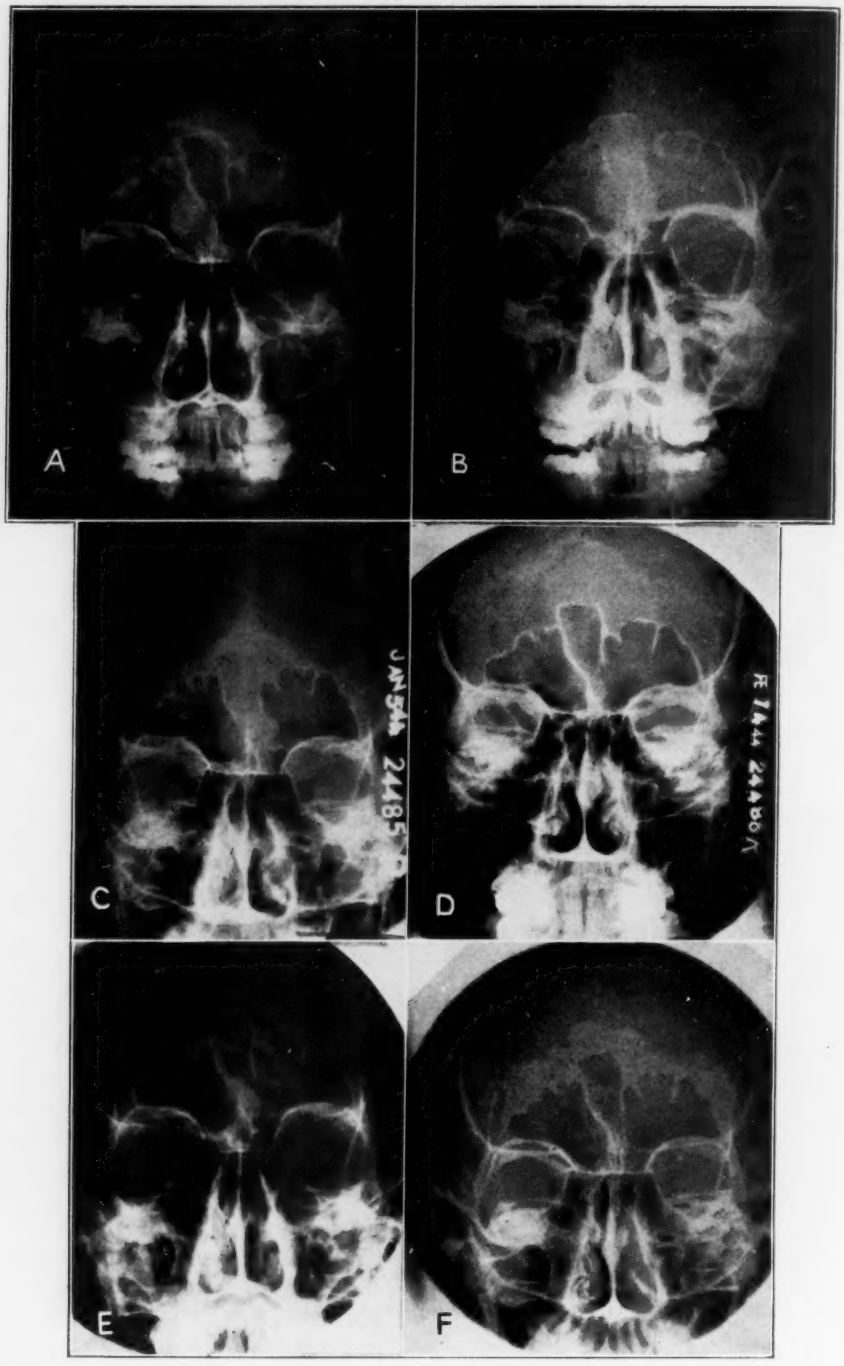

Fig. 5.—Series of roentgenograms of the frontal sinuses of Lt. E. S. In *A* there is a rounded shadow in the left frontal sinus. In *B* a similar shadow appears in the right frontal sinus, exactly opposite that in the left sinus. *C, D, E* and *F* show gradual clearing. The shadows are taken to represent submucosal or mucosal hematomas.

change in pressure would occur during a
d descent.

*gnificance of Rhinologic Findings in the
lification of Candidates.*—Can any estimate
asal function in relation to flying be gained
nasal examination? In other words, is it
ible to say whether or not a candidate with
rtain nasal apparatus can fly without diffi-
y? We think not. A large number of
idates have been seen with marked path-
nasal changes who have had no symptoms
ny kind on repeated flights in the low pres-
chamber. Many with repeated difficulty on
ent showed much less pathologic change on
mination than nonsymptomatic candidates.

he marked pathologic conditions in flyers
eriencing no difficulty include chronic sinu-
with opacity of the antrums from purulent
etions, cysts and polyps in the antrums,
ked deviation of the nasal septum, severe
rplastic changes from perennial allergies
nasal polyps occluding the nasal space. We
not infer that these men might never experi-
aerosinusitis, but on repeated flights they
not. Some of these men have flown exten-
y, as much as a thousand hours. One had
rge antral cyst but no difficulty. We do not
ve that these men should be qualified without
rection of their abnormalities. They are dis-
ed because of interest from the standpoint
asal physiology.

TREATMENT

The immediate treatment attempts to equalize the differential pressure within and without the sinus. This differential is responsible for the pain. Usually it is a decreased pressure within the sinus with an increasing pressure without, as occurs on descent. An ascent will bring the affected sinus to a level where the trapped air in the sinus will be of the same density as the outside air. There will then exist no differential, and the sinus duct or ostium may open easily, with relief of symptoms. Nasal shrinkage is then used to assure a patent opening. In the low pressure chamber leveling off and ascent are standard procedures when it is necessary to secure relief from sinus pains.

The treatment of a well developed condition such as that mentioned in foregoing pages will be according to the severity of the symptoms and the success of conservative treatment. Usually the pain in the sinus or the headache disappears in a short time and no treatment is necessary other than that for the sinusitis which was present prior to the flight.

There is one condition already spoken of which is typical of aerosinusitis, namely, hemorrhages in the sinus mucosa. This is mentioned again here under treatment to emphasize the advisability of doing nothing other than waiting for the hemorrhages to absorb. This will take place if the hematoma is not too massive.

PRIMARY INFECTION OF MAXILLARY SINUS BY ACTINOMYCES NECROPHORUS

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Reports of proved cases of primary infection of the maxillary sinus by fungi are scant, and primary infection by one of the Bacteroides has not been noted. Because of these facts and because of the excellent results obtained from the use of penicillin, the following case is reported.

REPORT OF A CASE

On Jan. 5, 1944, a 32 year old soldier in service for six months presented himself with the following complaints: recurrent sore throats, "stuffing" of the nose, postnasal drip and a feeling of "stuffing" in the ears. These complaints had been present since his induction into the service. Before being drafted he had worked as a cigar store clerk in Philadelphia. Physical examination revealed a congested and edematous nasal mucosa, impingement of the right vomer ridge of the nasal septum on the right middle turbinate and normal transillumination of the paranasal sinuses. The diagnosis at this time was vasomotor rhinitis, probably on a mechanical basis. A saline solution of neo-synephrine hydrochloride was prescribed for use as a decongestive agent in the nose.

The patient returned to the clinic on January 8, complaining greatly of his inability to breathe, and examination, including a general physical examination and a roentgenogram of the lungs, revealed nothing more. The patient's Wassermann reaction proved negative, and his blood count and his urine were normal.

The patient presented himself again on February 5, complaining of great pain in his left upper jaw. There was tenderness on palpation of the left canine fossa, and transillumination showed that the left maxillary sinus was dark. Irrigation of the left antrum was done, and a distinctively foul-smelling pus gushed from the trocar when it was first introduced. Pus was collected in a sterile test tube as it trickled from the trocar, before the actual irrigation was carried out. The specimen was sent to the laboratory for smear and culture.

An examination of the paranasal sinuses by roentgenogram revealed a uniform opacity of the left antrum.

The patient was admitted to the hospital with a diagnosis of empyema of the left maxillary sinus.

The laboratory report on the culture was that Actinomyces necrophorus and a symbiotic anaerobic streptococcus were grown, and a request for another specimen was made. The second culture proved to be the same, and since it was stated that A. necrophorus was a strict anaerobe, it was decided to instil zinc peroxide medicinal N. N. R. activated by dry heat for four hours at 140 C. into the antrum. Daily instillations of 1 Gm. of zinc peroxide made into a cream and oral administration of sulfadiazine, 2 Gm. every four hours, were started. The treatment courses that were followed and the results obtained are presented in the accompanying table. General physical examination and pulmonary roentgenograms again revealed nothing.

After February 21, when it was seen that the infection had not been affected in any way, it was decided to change the type of treatment. The sulfadiazine and zinc peroxide was discontinued. A saturated solution of potassium iodide, 20 m (1.23 cc.) three times a day, was then administered and after each daily irrigation of the antrum with sterile isotonic solution of sodium chloride the antrum was washed out with a 1 per cent aqueous solution of tincture of iodine U. S. P. On February 27 iodized poppyseed oil 40 per cent was instilled instead of the iodine solution, and a roentgenographic study was made. This showed a uniform thickening of the mucosal lining of the sinus to about ½ inch (1.3 cm.). On March 8 irrigations of iodine solution were discontinued, and after the saline irrigations thymol iodide was insufflated into the antrum through the cannula.

On March 8 all treatment with the iodides was abandoned, and penicillin therapy was started. Each day after the antrum was irrigated with saline solution, 3 cc. of penicillin solution (5,000 units per cubic centimeter) was instilled into the antrum. From March 10 to March 13, 200,000 units was administered intramuscularly at the rate of 25,000 units every four hours. As displayed in the table, the culture on March 14 showed a scant growth of the organisms. The pus diminished in amount, then lost its odor and finally was replaced by a mucoid secretion. On March 14 another course of penicillin was started by intramuscular injection, and 100,000 units was administered in the next twenty-four hours. The culture on March 16 was poor, and organisms could be obtained only in brain-heart infusion. The materials aspirated from the antrum on March 16 produced only a feeble growth of the anaerobic streptococci in the brain-heart infusion.

An irrigation was done on March 18, and a clear return was obtained. The water was blown out of the antrum, and iodized poppyseed oil was again instilled. Roentgenograms displayed such a great increase in the mucosal thickening that no more than a small oval mass of the iodized oil, the size of a pea, was seen. Because of the anaerobic nature of the infecting organism, and in the face of so great a mucosal hypertrophy it was felt that foci of the organisms might lie embedded and undetected in the depths of the tissue and would be responsible for a recurrence at a later date. A radical antrotomy was therefore indicated.

A Caldwell-Luc operation was performed on March 20, and the antrum was found to be almost completely filled with polyps and granulation tissue. This tissue was removed by curettage, and the specimen was sent to the laboratory for culture and tissue studies. In none of the mediums used was there any growth obtained except a feeble growth of an anaerobic streptococcus in the brain-heart infusion.

The pathologist's report on the tissue stated that the surface epithelium was well differentiated and showed areas of ulceration. The stroma was considerably thickened by scar tissue and chronic granulation

y infiltrated with a variety of inflammatory cells, plasma cells.

toperatively the patient's recovery was uneventful. wounds healed quickly, and the patient was dis- ed to duty. At the end of one month there was idence of any recurrence.

COMMENT

ere have been 10 previous proved cases of llary sinusitis in which a fungus, Asper- fumigatus, was found to be the responsible ism. Of these, 5 cases were reported by ,[1] 1 case by Harmer and Jockes,[2] 1 case killern [3] 1 case by Mackenzie,[4] 1 case by ari [5] and the last case by Adams.[6] Steven- son [7] told of 8 patients infected by an unclassified mold which he named Mucor histoides. There have been no reports of primary infection with Actinomyces in the maxillary sinus.[8] Voss [9] described a case of actinomycosis of the antrum secondary to an infection in the alveolar process of the maxilla. When the affected teeth were extracted, the antrum was uncovered and found to be full of pus. Actinomyces bovis was recovered from the pus taken directly from the antrum.

The organism obtained in the case reported has not in the past been recognized as a common pathogen in man. Veterinarians encounter the organism frequently and are well acquainted with the foul-smelling necrotic lesions which it produces. The physician sees it infrequently or fails to recognize it when he does meet it.

Schedule of Treatment and Results

ate	Irrigations	Medication	Culture	Comments
5/44	None	Neo-synephrine	None	Chief complaint stuffing of nose, postnasal drip and sore throat. Diagnosis: vasomotor rhinitis
5/44	Thick foul pus obtained on daily irrigations	ZnO_2 1 Gm. as cream; sulfadiazine 2 Gm. every 4 hours to total of 180 Gm.	Actinomyces necrophorus, anaerobic Str.	Chief complaint pain in left side of face; physical examination showed canine fossa tenderness, pus in left middle meatus and darkness on transillumination
1/44	Same	KI 20 minims (1.23 cc.) orally three times a day; iodine 1% solution irrigations	Same on 2/18/44 and 2/21/44 Same on 3/3/44	2/27/44 iodized poppyseed oil 40% instilled and roentgenogram showed filling defect of about ½ in. (1.27 cc.) due to mucosal hypertrophy
5/44	Same	Thymol iodide locally and KI orally	.....	.....
8/44	Same	Penicillin 15,000 units locally daily to 3/16/44	3/14/44 same but scant	Weak growth on blood plates, in thioglycolate and brain-heart infusion
0/44	Scant shreds of pus	3/10 to 3/13, 200,000 units of penicillin intramuscularly	3/15 poor growth	Growth only on brain-heart infusion
5/44	Mucus shreds			
		3/14/44, 100,000 units of penicillin intramuscularly	3/16/44, no A. necrophorus	Feeble growth of anaerobic streptococcus on brain-heart infusion only
8/44	Clear	Iodized poppyseed oil 40%	Negative	Increased filling defect; mucosal hypertrophy increased
0/44	Operation	.....	Negative	Tissue showed ulceration, scarring, chronic granulation and dense infiltration with plasma cells

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The first report of a case of human infection by this organism was made in 1891 by Schmorl [10] and told of abscesses developing on the fingers of a laboratory worker who was handling rabbits infected with these organisms. There was a spontaneous cure with merely local treatment. Ellerman [11] in 1905 described a case of infection in a 9 month old child who at autopsy was found to have diphtheritic-like laryngitis and pneumonia caused by this organism. In 1910 Steman and Shaw [12] cited a case in which a large ulcer developed on the back of the hand of a meat inspector from a scratch received after handling an ulcer on the lip of a sheep. This cleared up with nonspecific methods of treatment. A third case of cutaneous infection was described by Van Wering [13] in 1923. An ulcer developed on the forearm of a man after a bite by a cow. Healing resulted eventually after nonspecific local treatment. Cunningham [14] in 1930 reported 2 cases of infection with this organism ending fatally. In neither one of these cases was the nature of the infection realized until the organism was recovered from autopsy material. The first case was that of a young woman with a pulmonary abscess and an abscess in the region of the loin from which the organism was obtained in pure culture. The second case was that of a 64 year old man with a retropharyngeal abscess and a purulent pericardiac effusion. Culture of the former yielded pneumococci of group IV and A. necrophorus while the pericardiac fluid yielded pure cultures of A. necrophorus. Shaw and Bigger [15] cited in 1934 the case of a Negro with a typical history of a pulmonary abscess and roentgenographic findings of a large abscess in the left lung. This abscess was drained externally, and the patient recovered. Dack, Dragstedt and Heinz [16] have reported the organism as the etiologic fa a series of cases of ulcerative colitis. patients had ulcerative lesions which ap characteristic when viewed through th moidoscope. Cultures of material from lesions yielded the organism A. necrophor

BACTERIOLOGY

Morphologically the organism was fou be a short bipolar gram-negative coccob with rounded ends or slightly longer rod stained solidly. It was also seen as a w cluster of gram-negative strands and longe having regularly arranged, deeper-staining coid bodies, or as long tangled filaments deep-staining coccus-like masses. In shor the staining was irregular and terminal were usually present. On solid medium filamentous forms were more numerous large trunks were present with branches terminal polar body in the end of each b

The organism is an obligate anaerobe, a cultures all have a characteristically foul It supposedly grows best in ascitic fluid, a the mediums used in our laboratory th growth was obtained on the brain-heart sion and in cystine cultures. On blood plates the colonies appeared as yellowish dirty convex lenses, each surrounded by a of hemolysis. To prove definitely the id of the organism, its cultural characteristics studied, and it was found to be a gas an producer with dextrose, sucrose, lactos mannitol. With xylose there was no fer tion, and with salicin there was only gas duction. No growth was obtained in plain gelatin, milk or inulin serum. These acteristics all fulfilled the points for identifi as set forth in Bergey's "Manual of Deter tive Bacteriology." Unfortunately blood titrations were not done in this case.

TREATMENT

The treatment of infections by organis the Actinomyces group has been variable past, and most writers favor the combinat roentgen, surgical and iodide therapy. To the effects of penicillin and similar subs have been scantily reported and varied. patients have responded well and others all.[17] Despite the fact that penicillin is

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be particularly effective against an infec-
ue to a gram-negative organism, against
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SUMMARY

A primary infection of the maxillary sinus was caused by Actinomyces necrophorus.

The infection cleared completely and promptly with the combined systemic and local treatment with penicillin.

To prove that the infection was definitely overcome the sinus membrane was removed and cultured and found to be free of the organism.

Despite the fact that A. necrophorus is a gram-negative organism, it responded well to penicillin but not at all to sulfadiazine.

VITAMIN THERAPY IN OTOLARYNGOLOGY

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Recent investigations confirm the general rule of vitamin therapy, that a vitamin can relieve only those symptoms caused by its deficiency. The avitaminotic diseases are clinical entities with a definite pattern of symptoms and pathogenesis both in man and in laboratory animals. Experimentation with animals has been invaluable in demonstrating the significance of human symptoms, but the demonstration of a lesion in an acutely fulminating vitamin deficiency experimentally induced in the laboratory animal is not a scientific basis for the assumption of the existence of a similar condition in latent avitaminosis in man. Manifest avitaminotic diseases are rarely if ever encountered in otolaryngology; only the latent are seen. The difference between manifest and latent avitaminosis is that between a complete clinical picture and a picture of a few of its essential parts. The diagnosis is frequently difficult and uncertain even by the therapeutic test with the specific vitamin concerned. The time necessary for the reversing processes of the different vitamins varies greatly, not only among them but also among the various stages of the avitaminosis. The tests for the presence of vitamins, while available for research laboratories, are hardly suitable for clinical laboratories. The fascination of the study of avitaminotic diseases in otolaryngology is their variability in everything save therapy. That remains constant.

The literature on vitamins, vitamin deficiencies and their treatment is now so enormous that a review of the literature has become an end in itself. Excellent bibliographies have been recently prepared by Jones [1] and by Bicknell and Prescott.[2]

Vitamin A.—Mori,[3] using laboratory animals, presented the first thorough pathologic study of vitamin A deficiency. Wolbach and Ho three years later established metaplasia of mucous membrane as the characteristic le of the avitaminosis. The resultant pathoge is from this metaplasia as it is modifie inflammation. Wilson and Dubois,[5] Blac and Wolbach [6] and Sweet and K'ang [7] demonstrated at human autopsy that the pa genesis in man is essentially the same as in laboratory animals. Sweet and K'ang studies on 203 Chinese with clinical deficie in vitamin A, in the course of which they formed 17 autopsies. At the autopsies, ty epithelial metaplasia in the larynx or tra was found in 8 cases. In 17 of the ge group, scrapings of the nose were made cornified epithelial cells were found. Six o subjects were found to have atrophic rhi While several observers had previously gested avitaminosis A as one of the cause atrophic rhinitis, it remained for Sweet K'ang to offer evidence.

Mellanby,[8] Wolbach and Bessey,[9] Cov and Perlman and Willard [11] have describe young dogs with vitamin A deficiency an e tosis in the internal auditory canal sufficien touch the eighth cranial nerve and a perio

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sit in relation to the otic capsule. Perlman Willard reported that there was no degen- on of the auditory nerve and that the hear- remained good. Abscess of the middle ear occur with the fulminating type of this minosis in infants and children, but in no otologic condition has vitamin A deficiency demonstrated as an etiologic factor in im- d hearing in human beings.

itamin A has no effect on immunity. When diet contains an optimal amount of vita- A, further administration of the vitamin is benefit in preventing or improving infec- of the ear, nose or throat. It is of no in the treatment of infections unassociated metaplasia of the mucosa due to nutri- deficiency. The benefiting of frequent and rrent colds by the administration of vita- A proves merely the existence of a defi- of the diet.

he initial symptom is usually from the nose, in the eye and later in other organs without definite order of precedence. There are no nasal symptoms or signs characteristic of avitaminosis. The history of persistent ffles"; a diet deficient in milk, butter, carrots, ach and tomatoes, and a bilateral mucoid harge becoming thicker and more profuse gest the therapeutic test of cod liver oil ovitamin A and D, U. S. P.) 3 drachms a (11.65 Gm.) or its equivalent of 10,000 S. P. units, with the correction of the faulty Definite improvement in infants and chil- with the avitaminosis should be apparent ween fourteen and twenty-one days after ming treatment.

itamin A is indicated in a certain type of nic sinusitis in addition to the local treat- t. A history of a deficient diet and nasal harge, stuffy nose or "clucking noise" in the at occurs, but is rare, in children usually ween 5 and 13 years of age. Examination ws the nasal mucosa only slightly hyperemic. hick, viscous, gray, mucopurulent, bilateral harge is observed in the ethmoid regions. antrums are clear to transillumination. The rior turbinates are turgescent in some, and nasopharynx is visible in others. There is sneezing. Chronic sinusitis from avitaminosis shows improvement after administration of min A for a month in a daily dosage of 00 units. Recurrence is prompt unless the ary habits are changed or vitamin A is tinued.

trophic rhinitis may be a sequela of chronic usitis from avitaminosis. However, atrophic nitis probably has several etiologic factors of which avitaminosis is only one. Evidence [12] has been submitted that the characteristic of epithelial metaplasia in avitaminosis in the rat and in man is a process that may be reversed by adequate dosage of vitamin A for a sufficient length of time. In the rat, the reverse metaplasia bringing the epithelium back to health requires four months, in a child eight months and in the adult longer. The differential diagnosis between atrophic rhinitis due to avitaminosis and that due to other causes is uncertain and unsatisfactory, since the therapeutic test extends over the prolonged period at present necessary for the reversing process. This vitamin has been of no benefit in the treatment of allergy.

Vitamin B Group.—Pellagra, ariboflavinosis and latent beriberi probably have a higher incidence and wider distribution in this country than all other avitaminotic diseases. The usual diet of Americans, particularly in the South, is closer to the level of clinical deficiency for the vitamin B group than for any other. The influence of the climate is of primary importance, as it affects both the human requirement for the vitamin B group and the production of the vitamin in growing plants and animals used as food. The incidence and the severity of symptoms of pellagra have long been known to increase during the spring and summer and to decrease during the fall and winter. Mills [13] has reported that rats require, per gram of food, twice as much thiamine hydrochloride at the atmospheric temperature of 91 F. as at 65 F. to prevent the development of thiamine deficiency. Also, foods in the form of cereals, vegetables or animals grown in a warm or hot climate develop a lower content of the elements of the vitamin B group than those grown in colder regions. Veasey [14] has emphasized the clinical importance of the variations in thiamine content of foods, which in turn is dependent on climate and soil. People living in warm climates, such as that in the South, are under a double handicap; the high atmospheric temperatures increase the optimal requirement for the vitamin B group and at the same time decrease the vitamin content of their food.

The general etiologic factors for a clinical deficiency of the vitamin B group are a relatively

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low and highly variable vitamin content of the usual foods, rather meager storage facilities for these vitamins in the human body and their rapid metabolism or excretion. Alkaline fluids rapidly destroy the vitamins of the B group. The methods of processing and preparing foods for the table affect their thiamine content. Ordinary cooking destroys about 25 per cent of the thiamine present, while a much higher percentage disappears from pressure cooking. In the individual person, the requirements for thiamine hydrochloride are increased by hyperactive metabolism such as that induced by fevers, hyperthyroidism, increased physical activity or hard work; by a large carbohydrate intake, and by decreased absorption because of vomiting, diarrhea and other alimentary conditions.

Pellagra is the result of the multiple deficiencies of nicotinic acid, riboflavin, thiamine hydrochloride and possibly of other vitamins. Nicotinic acid relieves the general symptoms summarized in the mnemonic phrase, "diarrhea, dermatitis and dementia," but does not relieve neuritis, cheilosis, edema or the cardiac symptoms. Consequently, nicotinic acid—or better, nicotinamide—occupies a secondary or supplementary place in vitamin therapy of otolaryngologic conditions. Patients with moderate or severe cheilosis occurring independently or as a complication of pellagra, consult other physicians besides otolaryngologists. The otolaryngologist sees cheilosis and fissuring at the angles of the lips due to ariboflavinosis when they are observed incidentally to an examination for other diseases.

Thiamine Hydrochloride.—While the occurrence of manifest beriberi in this country is extremely rare, latent beriberi in its various aspects is not infrequent. Manifest beriberi has an insidious onset and presents symptoms of neurasthenia, polyneuritis and edema and occasionally sudden cardiac death occurs. The clinical picture is not so distinct and regular in latent as in manifest beriberi; but latent beriberi has the same general outline as the manifest with some of the symptoms blurred or missing and others by comparison slightly exaggerated. The presenting otolaryngologic complaints associated with latent beriberi may be nasal discharge, sore throat, hoarseness, a lump or ball in the throat, difficulty in swallowing, tinnitus or impaired hearing. A history of neurasthenic symptoms is given with vague and indefinite emphasis placed on two or more of these symptoms: nervousness, headache, malaise, muscular weakness, insomnia, anorexia and transient pain in the extremities, abdomen or back. Neuritis is indicated by pain and tenderness over one or more of the peripheral nerves. Abadie's sign is positive; that is, there is pain in the musc the calf of the leg when they are squeezed. in the legs on squatting is occasionally pr The patellar reflex is hyperactive in early and absent in chronic, or it may be no Neurasthenia and polyneuritis are essenti the diagnosis of thiamine deficiency affectin ear, nose and throat. Neurasthesia, polyne and faulty diet are invariably present i otolaryngologic conditions subsequently scribed. Specific mention of them is omitt avoid needless repetition.

A nasal syndrome [12] has been identified thiamine deficiency. The presenting comp is slight but frequent postnasal discharge. M is expectorated at short intervals. Sneezi occasional but does not occur in bouts. T is no headache. Young women are most affected. On anterior examination, the mucosa appears practically normal except the middle turbinates. The posterior tips o middle turbinates have a smooth, moist, cr white, thickened and slightly edematous ap ance. Mucus is seen in various locations bu regularly in any one place. No mucopu found. The leukocyte and differential count normal. This edema of the ethmoids is re differentiated from nasal allergy and h plasia. Under a therapeutic test of 30 m thiamine hydrochloride a day the disch lessens in three days and ceases in four

A pharyngeal syndrome has the prese complaint of sore throat and occurs more quently in the summer and autumn. The is mild to moderate and varies in loca Swallowing is sometimes painful but frequ is not. The pharyngeal mucosa may ap normal or slightly hyperemic. No eviden infection is apparent, and the tonsils, when ent, are normal. The mucous membrane the arytenoids and between them is sm thickened and ranges in color from hyper to normal, giving the appearance of an inf tive edema. On phonation, this mucosa ass a cuboid form and almost a redundant ap ance as it presses backward against the h pharyngeal wall.

The clinical appearance of the enlarged tenoids in thiamine deficiency and in tubercu of the larynx is somewhat analogous. In amine deficiency the form of the aryteno similar to, the size smaller and the texture fi than that in laryngeal tuberculosis. The op requirement of thiamine is increased in ch pulmonary tuberculosis. It is hardly an ass tion to conclude that thiamine deficiency is of the etiologic factors of hypertrophy o arytenoids in tuberculosis of the larynx. Hy

...y of the arytenoids in laryngeal tuberculosis ...been observed to decrease in size within ...n days from the administration of 30 mg. ...iamine hydrochloride a day, but conditions ...ot return to normal.

...ients with globus hystericus who have ...n of the arytenoids typical of thiamine defi... are relieved of their symptoms within five ...by 30 mg. of thiamine hydrochloride a day. ...s difficult to decide in hysterical patients ...her the improvement is due to suggestive ...py or the thiamine hydrochloride, but under ...treatment the neurasthenia and pains also ...pear. Of course, not all cases of globus ...ricus are due to thiamine deficiency, but, ...s just been demonstrated, some of them are.

...e laryngeal syndrome producing voice ...ges present two clinical pictures: One ...s occasionally in the edentulous aged, ...ly in women, and the other, extremely rare ...is seen in infants. In the aged, the voice, ...ugh strong, rapidly tires on talking and has ...uliar sound as though the end of a syllable ...ord is split or fuzzy. Edema of the ary... ...ds is present, and the vocal cords are moist, ...gh normal in color. On phonation, the ...s of the vocal cords are brought together ...cannot be held in close approximation and ...re slightly separated. The vocal cords ...me dry and normally approximated and the ...clear after ten to fourteen days on 30 mg. of ...mine hydrochloride a day. Alcantara and ...Ocampo [15] have reported the effects of thi... deficiency on the larynx of the infant ...een the ages of 1 to 9 months. Voice ...ges from weakness to aphonia were the ...t frequent symptoms, with occasional dysp... ...and cyanosis. Johns [16] has noted edema of ...rytenoids in infants with beriberi. Alcantara ...de Ocampo, on direct laryngoscopy, found ...ctor, adductor and tensor paralyses. An ...t 9 weeks old (referred by Dr. J. H. Park), ...was normal except for stertorous breathing, ...nea, cyanosis and a peculiar cry, showed on ...t examination with the laryngoscope slight ...remia of the vocal cords and partial ...ral paralysis of the abductors. The ster... ...s breathing, cyanosis and dyspnea had im... ...d on the fourth day after dosage of 4 mg. of ...mine hydrochloride a day and had dis... ...ared on the tenth day.

...rodie,[17] in an experimental study on young ...born of mothers on a minimal thiamine diet during pregnancy and lactation, demonstrated pyloric stenosis and degeneration of the tenth cranial and sciatic nerves. Etzel [18] has proved that avitaminosis B_1 is one of the causes of cardiospasm and degeneration of Auerbach's plexus extending beyond the lower third of the esophagus. As a consequence the dilatation of the esophagus (megaesophagus) and the frequently associated findings of achalasia, achlorhydria, megacolon and electrocardiographic changes occur. Jankelson,[19] Stinson [20] and Merrill and Richards [21] have confirmed Etzel's observations and presented additional data.

Recently an elderly edentulous patient with a long history of dysphagia and restricted diet was referred to my associate, Dr. Foster. He easily passed an esophageal bougie into the stomach without experiencing any sensation of resistance. The patient was admitted to the hospital and, though apparently a good operative risk, died suddenly the next day while talking to the nurse before the esophagoscopy was to be done. Dr. V. Keiller performed the autopsy and found no evidence of trauma to the esophagus and no notable cardiac lesions. There was a megaesophagus containing a considerable amount of food, and fibrous bands appeared at the cardiac opening. The findings were otherwise negative. To sum up: This was an edentulous patient, on a restricted diet, with dysphagia, achalasia and megaesophagus. The vitamin B in her diet was reduced through retention in an alkaline fluid in the enlarged esophagus for twenty-four hours or more. A sudden cardiac death resulted. Dr. Keiller also reported an autopsy on another patient which demonstrated a megacolon from unexplained cause and cardiac death. The evidence may not prove conclusively the cause of death to have been due to a thiamine deficiency, but the clinical conditions and those observed at autopsy in 2 cases are sufficient to direct attention to avitaminosis B_1 and arouse suspicion that latent beriberi is more frequent and important than has hitherto been assumed.

...Alcantara, V. C., and de Ocampo, G.: Larynx in ...ile Beriberi, Arch. Otolaryng. **30**:389-399 (Sept.)

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Ono [22] demonstrated in the rat, on a thiamine deficient diet, a degeneration of the medullary sheath of the eighth cranial nerve. Covell [10] and Perlman and Willard [11] have confirmed this and presented additional data. Selfridge [23] and Harris and Moore [24] have reported benefit to impaired hearing and tinnitus from thiamine, but Childrey [25] has contradicted this. Veasey [14] concluded that impaired hearing and tinnitus in some patients can be improved by thiamine hydrochloride; the difficulty is to select those who can be benefited. The evidence now is that thiamine hydrochloride can improve tinnitus and impaired hearing only in those patients with latent beriberi. Neuritis of the eighth cranial nerve from thiamine deficiency usually appears late in the disease and is associated with other symptoms of latent beriberi. Aring and Spies [26] advised 100 mg. of thiamine hydrochloride a day for seven days in the treatment of neuritis due to thiamine deficiency.

Thiamine hydrochloride is effective for a few conditions in which the precise relationship to nutritional deficiencies is not at present clear. Martin and Moursund [27] demonstrated that thiamine hydrochloride affords protection against the toxic effects of roentgen rays. This has been amply confirmed. Nicotinic acid and ascorbic acid are likewise used for the same condition. Dr. John J. Shea in a verbal communication confirms by clinical experience the observation of Parade [28] that thiamine hydrochloride has a synergistic action on thyroid.

Ascorbic Acid.—That some persons are susceptible and others resistant to vitamin C deficiency is the only conclusion possible from the present rather contradictory reports on human requirements for ascorbic acid. Croft Snorf,[29] in an examination of 100 patient the high economic level, found that 38 had min C deficiency or subclinical scurvy, these, 92 per cent were on a vitamin C–defi diet, and the 8 per cent on an adequate diet an unusually high requirement for ascorbic

Hochwald [30] has reported that ascorbic benefits hay fever, but this conclusion is in pute. I have prescribed 200 mg. of ascorbic a day to many patients with hay fever sy toms with no benefit to some and improve or cure in others. The symptoms of the g which showed no benefit were diagnosed as allergy. But the improvement or cure in other group indicated that vasomotor rhi may be an early symptom of latent or subcli scurvy. Nearly all of the latter group found to be on diets containing little o citrus fruits or fresh vegetables. Nasal ex nation showed a pale mucosa with a petechia e on the anterior tip of the inferior turbinat on the septum in some and a hyperemic tur cent mucosa in others. In still others no dis signs were detected for differentiation from usual allergic mucous membrane. The g became noticeably paler after ascorbic acid given, and the gingivitis, when present, proved. A vitamin C–deficient diet, an occasi petechia on the nasal mucosa and gingivitis particularly a positive therapeutic test of asc acid warrant the conclusion that latent scur one of the etiologic factors of vasomotor rhi

Vitamin D.—Vitamin D has a function in metabolism of calcium and phosphorus and the maintenance of their normal ratio to e other. Vitamin D may raise the level of se calcium, correct the hypocalcemia of tetany parathyroid insufficiency and so be effectiv the treatment of tetany due to low blood calci

Laryngismus stridulus is a symptom of tet The diagnosis of latent tetany between att of laryngismus stridulus may be difficult, then the infant or child appears quite w However, either Chvostek's sign or Trousse sign is usually positive and so proves the hy excitability of the motor nerves, a character of tetany. The dose of vitamin D is from to 2,000 U. S. P. units a day, supplemented calcium, depending on the size of the infant child and the severity of the symptoms. T dose is not toxic, but if a large dose is to given to a small infant, an estimation of bl

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m is advisable. The therapeutic action of in D is slow and does not become effective even days.

rathyroid deficiency is a rare complication yroidectomy. Its symptoms are spasm of lottis, dyspnea, cyanosis and tetany. These be alarming and even fatal. An estimation rum calcium should be made frequently in ifest tetany. Parathyroid extract (para-id injection U. S. P.) is administered for n days, after which antibodies inhibit its er usefulness. Synthetic oleovitamin D S. P. is started with the parathyroid extract. average dose is 1½ minims (0.09 cc.), but is increased as the amount of serum calcium

CONCLUSIONS

The latent forms of nutritional diseases affecting the ear, nose and throat are vitamin A deficiency, beriberi, ariboflavinosis, pellagra, scurvy and rickets. Their presenting symptoms in otolaryngologic conditions are merely parts of the clinical pictures of these deficiencies. Diagnosis of one is the indication for its particular vitamin. The diagnostic methods are at present clinical examination and therapeutic tests; suitable laboratory tests for clinicians are hoped for in the future. The therapeutic action of the vitamins is precise and specific. Consequently, the otolaryngologist in prescribing vitamins should treat diseases and not symptoms.

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A PROCEDURE FOR ELEVATION OF THE NASAL DORSUM BY TRANSPOSITION OF LATERAL CARTILAGES

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In a previous communication (1932)[1] I described a method for utilization of lateral cartilages for the elevation of the line of the nasal bridge. This procedure was especially designed for the filling out of depressions located at the middle third of the dorsum, thus dispensing with the use of free grafts, which are often difficult to shape accurately and immobilize in this area. Modifications of this procedure proposed subsequently by others do not carry out its original purpose.[2] I wish to elaborate here on a few points pertaining to this surgical method and its indications.

Whereas the elevation of the entire nasal dorsum by means of a bony or cartilaginous graft is at present an accepted procedure, the method of the repair of some circumscribed dorsal depressions is open to question. An accurate fitting of a small graft on the dorsum is often difficult, as its partial absorption or slightest displacement is liable to mar the end result. The utilization of the neighborhood nasal structures for the repair of these defects is of definite advantage and should be resorted to whenever possible. A great advantage in the use of these structures is that they assure permanence of volume and good immobilization. As most nasal depressions are of traumatic origin, there is often simultaneous thickening of the upper lateral cartilages due to perichondritis. This excess of fibrocartilage can be used with advantage as filling material, and its shifting to the midline corrects simultaneously the excessive width at that level. The same procedure applies to the mobilization of the lower lateral cartilages, which can be easily disconnected from the surrounding structures and affixed in a higher position, thus correcting certain malpositions of the nasal tip. In conjunction with the transposition of the lateral cartilages, there are often indications for the elevation of the bony dorsum through infraction of the frontal processes of the maxilla. These steps can be carried out separately or together, depending on the need.

SURGICAL METHOD

The upper lateral cartilages are loosely connected with the pyriform aperture and are in continuity with the dorsum with the septal cartilage. They can

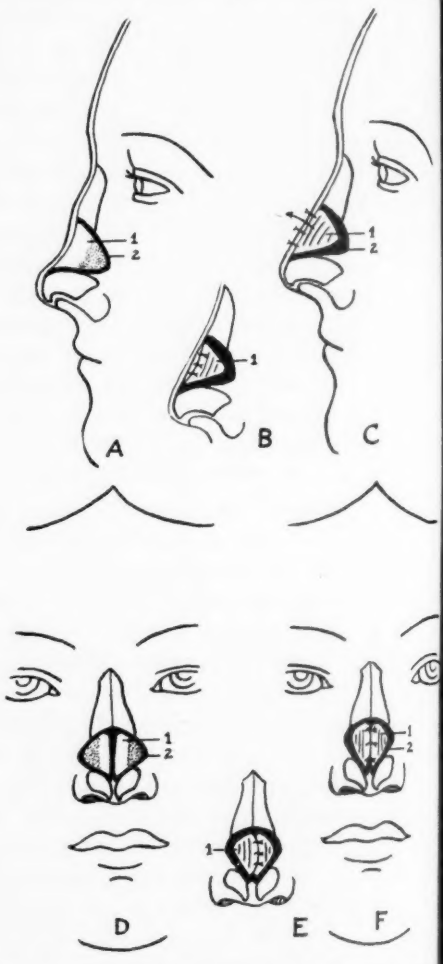

Fig. 1.—*A*, dorsal depression in the middle third of the nose such as often occurs following external trauma. The upper lateral cartilages (*1*) in such instances are often apt to be thickened and deformed. *B* and *C*, the lateral cartilages are severed from the pyriform aperture (*2*) and from the underlying mucous membrane. The pliability is increased by multiple incisions if required. The cartilages are affixed in the depression by approximation or superposition. *D*, *E* and *F*, side views of *A*, *B* and *C*.

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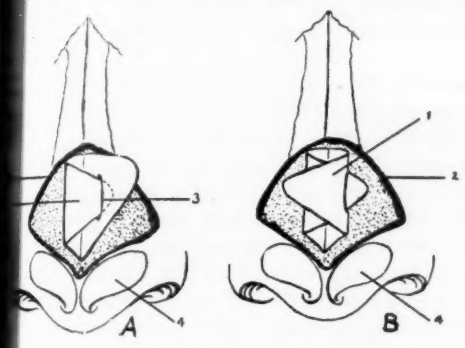
toward the dorsum in the following manner: rough severance from the septum, partial under- and overlapping or (2) through leaving the connection intact and mobilizing the distal ends, are bent over and affixed medially in the depres- Lateral cartilages thickened as a result of trauma as in boxers and football players) may require



2.—*A*, transposition of the cartilages made by g the distal end of one cartilage (*1*) through a hole (*3*) made in the other.

the doubling up of the cartilages permits the fill- t of defects of greater depth. The alar cartilages an be handled in the same way as the upper lat- nes for the purpose of elevation of the nasal tip.

shaping to provide the necessary pliability for the transposition. The cartilages are affixed in place by approximation or superposition.

The operative field is exposed through incisions under the lower border of the triangular cartilages and the undermining of the dorsal skin. The cartilages are disconnected along the upper edge of the pyriform aperture, and their lower surface is freed from the mucous membrane. If necessary their connection with the septum is severed with scissors, and they are then shifted into the depressed area, where they are affixed with catgut sutures (fig. 1).

A modification of the older technic consists of doubling up the cartilages on each side and passing them through a buttonhole (fig. 2).

SUMMARY

A procedure for the elevation of limited depressions of the nasal dorsum has been devised and elaborated. It consists of the endonasal transposition of the upper lateral cartilages and their affixation in the depressed area.

The use of free grafts, often inadequate for this purpose, is thus made unnecessary.

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Case Reports

VALUE OF ROUTINE ROENTGENOGRAPHIC STUDIES OF WAR INJURIES OF THE HEAD AND NECK

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The case to be presented gives pictorial evidence of the value of routine roentgenographic studies in dealing with all war injuries of the head and neck in which the presence of a foreign body is remotely suspected. Routine roentgenographic examination of all injuries of the head and neck has been adopted as a matter of policy in the otolaryngologic, ophthalmologic and maxillofacial departments of the evacuation hospital at which I am stationed since its first admission of war casualties in February 1942. The use of this additional diagnostic safeguard has amply rewarded the medical officer for the care expended by rendering valuable information concerning the retention of radio-opaque foreign bodies in war injuries of the head and neck in patients in whom the presence of these foreign bodies would otherwise have passed unnoticed. In several instances it has saved the inevitable clinical complications and professional embarrassment that accompany the omission of available diagnostic procedures.

REPORT OF A CASE

A first lieutenant, white, aged 24, attached to a United States Army infantry division in the South Pacific area was wounded March 12, 1944 in the left orbital region by a fragment of an artillery shell. The left globe was enucleated, and a large ragged laceration of the lower left eyelid and adjacent region of the cheek was repaired with linen sutures within three hours after injury at a nearby evacuation hospital. A small laceration of the right brow was similarly closed. No roentgenographic studies were considered necessary despite available radiologic facilities. He was evacuated to this hospital March 17, 1944, at which time he was free of complaints except for a sensation of tenderness in the region of the left orbital wound, which had become secondarily infected.

This officer had had nine attacks of malaria, the most recent attack occurring in November 1943.

Physical Examination.—There was a recently healed laceration of the right brow, approximately 2 cm. in length. The left eyeball had been recently enucleated. There was a depressed irregular laceration of the midportion of the left lower eyelid, approximately 4 cm. in length. This laceration extended laterally at an angle of about 45 degrees. Stitch infection about the linen sutures was present, with considerable tenderness, hyperemia and edema of surrounding tissues. (Immediate removal of the sutures and application of hot wet ings resulted in prompt cessation of the infective p and firm closure of the wound by secondary inte

Roentgenographic Studies.—There was a comm fracture of the maxilla involving the inferior rim orbit with all the fragments in good position. was a large metallic fragment lying just below th orbit, close to the nares on the left side. An trocar was introduced into the left antrum throu inferior nasal meatus. Sharp pain was elicited the point of the trocar encountered the foreign Iodized oil was introduced into the antral cav

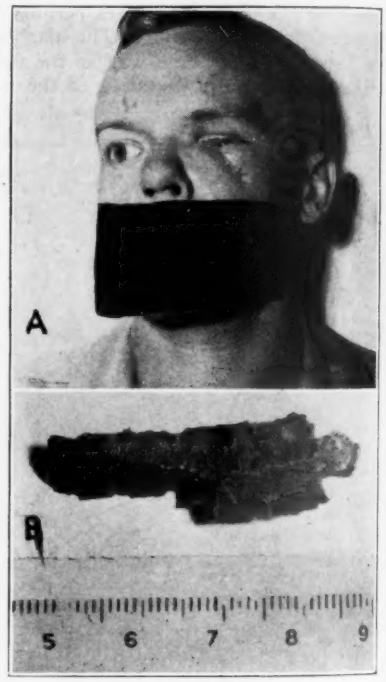


Fig. 1.—*A,* healed facial wound at the site of of an enemy artillery shell fragment. The fra fractured the left inferior orbital margin, penetr the anterior wall of the left maxillary sinus and l within the sinal cavity. *B,* enemy artillery shell ment removed from the left antral cavity.

way of the antral cannula. Additional roentgenogr studies with cannula and contrast medium in pla vealed that the foreign body lay within the sinal c

Operation.—On March 21, 1944 the left antral c was opened under local anesthesia by means of the well-Luc procedure. An irregularly rounded 2 by traumatic opening into the antrum through the an surface of the maxillary sinus was found and enl

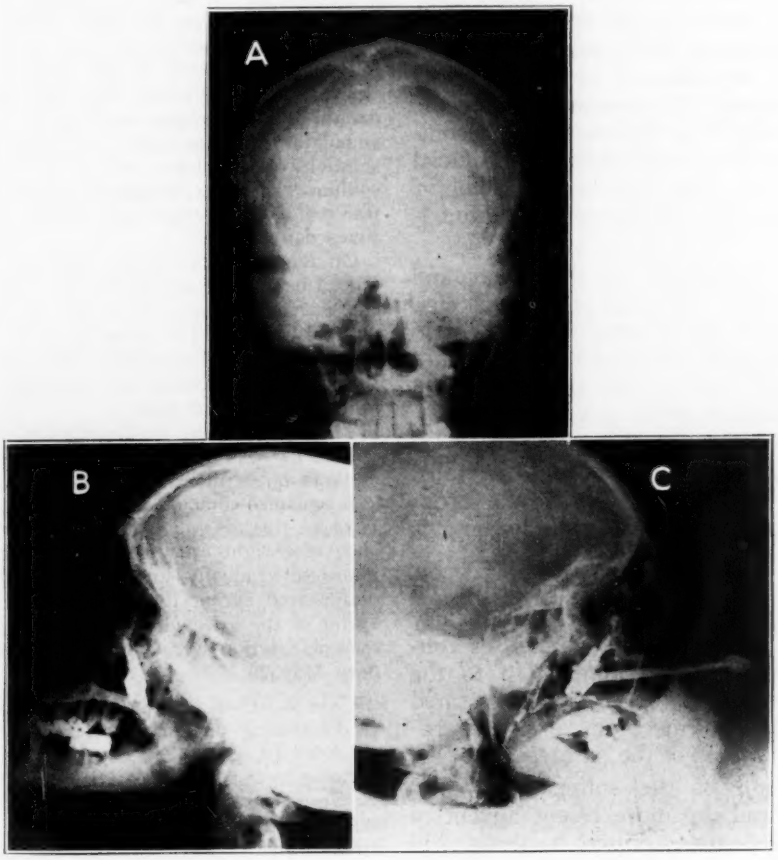
iting forceps. This exposed a large (4 by 1.75 ragment of an artillery shell lying firmly wedged the antral cavity. The foreign body was ged with considerable difficulty. No excessive g was encountered. The oral wound was closed lack silk. No packing was considered necessary.

operative Course.—Convalescence was uneventful. ound healed primarily, without evidence of sinal on.

of this evacuation hospital during its past eighteen months of operation.

SUMMARY

A war casualty from the South Pacific combat area had an unsuspected large fragment of Japanese artillery shell lying wholly within the cavity of the left maxillary sinus. This was demonstrated as a result of the making of routine roentgenographic studies of all penetrating wounds of the head and neck in which the presence of a retained foreign body might even remotely be suspected. This has been one of many cases in which the routine use of this diagnostic safeguard has provided the medical officer with valuable information.



g. 2.—*A*, anteroposterior roentgenographic view of the skull, showing the position of the fragment within ft antral cavity. *B*, lateral view of the fragment, lying within the left antral cavity. *C*, lateral view of the ntrum with the fragment, the antral cannula and the contrast medium (iodized oil) in place.

COMMENT

hile this case dramatically illustrates the e of routine roentgenographic studies of all wounds in which a retained radio-opaque gn body might be suspected, it is only one any similar but less spectacular cases conted among war casualties in the otolaryngic, ophthalmologic and maxillofacial wards

FACIAL PARALYSIS IN ACUTE OTITIS MEDIA AND THE USE OF PENICILLIN

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The occurrence of facial paralysis in the course of acute otitis media is a rare and alarming development. The preoperative incidence is reported by Kettel [1] to be 0.5 per cent.

The possible causes of the paralysis advanced by Brunner [2] are as follows: (1) infection of the nerve by contact; (2) compression of the nerve by hyperemic blood vessels which accompany the nerve; (3) a lymphangitis in the facial nerve canal, or (4) toxic paresis of vasomotor nerves and consequent disturbances in the nutrition of the nerve.

Lederer and Hollender [3] in their text and Brunner [2] divide cases of facial paralysis occurring in the course of acute otitis media into two groups: (1) those in which the paralysis appears in the first days of the acute otitis, in which the prognosis is good and the treatment that of simple otitis media; (2) those in which the paralysis appears during or after the third week of the otitis media, in which the prognosis is not as favorable and mastoidectomy is advocated.

In the last few years the literature on the subject of facial paralysis occurring early in the course of acute otitis media stresses conservative, nonoperative treatment. Up to the early 1930's, writers on this subject advocated mastoidectomy on an emergency basis regardless of the time of onset of the paralysis.

The introduction of the sulfonamide compounds in 1937 and the more recent advent of penicillin have led to a critical analysis and revision of some surgical indications in acute otitis media and disease of the mastoid process. That the appearance of facial paralysis in this type of case will be regarded as a medical and not a surgical problem is strongly suggested by the efficacy of penicillin in the treatment of acute otitis media. This applies even though the facial paralysis appears in the third week or later, provided, of course, that there are no other indications for surgical intervention, such as sagging of the posterior wall of the external aural canal or other signs of intracranial complications.

1. Kettel, K.: Facial Palsy of Otitic Origin, Arch. Otolaryng. **37**:303-348 (March) 1943.

2. Brunner, H.: The Clinical Significance and the Treatment of Otogenous Facial Paralysis, Laryngoscope **49**:276-290 (April) 1939.

3. Lederer, F. L., and Hollender, A. R.: Textbook of the Ear, Nose, and Throat, Philadelphia, F. A. Davis Company, 1942.

REPORT OF CASES

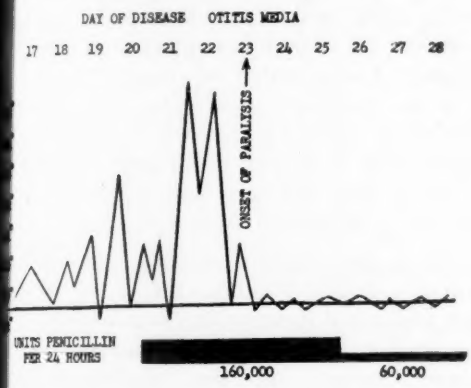
CASE 1.—R. K., aged 31, contracted a head cold a few twinges of pain in the right ear on March 1944. The next day his right ear began to discha however, he did not report to a medical officer until following day. When he was first seen in the oto clinic, forty-eight hours after the onset, the ear painful and discharging moderately. His treatment ambulatory and consisted of nose drops of a 1 per solution of ephedrine sulfate in isotonic solution sodium, ear drops of glycerin containing phenol per cent concentration and 1 Gm. of sulfadiazine times daily.

On the sixth day of his otitis media he was h talized because of increased aural pain and profuse charge from the ear. There was no tenderness ove mastoid process. The temperature was 99.2 F. On admission a right-sided facial paralysis was noted. sulfadiazine medication was intensified to 1 Gm. e four hours day and night.

The response to hospitalization and to intens medication was prompt, for on his fifth hospital day ear was dry, with a healed perforation. The facial p ysis remained complete until the eleventh day when, physical therapy, minimal muscular action was not about the right eye. From this time on the para improved gradually, and six weeks after the onset disappeared except for some lag on closing the u eyelid of the affected eye. The hearing and the f muscular action were normal at the time of return duty May 26.

CASE 2.—D. K., aged 32, a convalescent soldier reconditioning program, had a sore throat with f on April 19, 1944. Six days later he complained o earache on the left side. His temperature was 102. Because of a painful, bulging drum, myringotomy done under local anesthesia, with release of st colored fluid under pressure. Sulfathiazole therapy started immediately, 1 Gm. being given every four h with initial large doses. Clinical improvement, denced by decreased discharge, normal temperature absence of pain, led to discontinuance of the use of drug after five days. This was followed in twenty- hours by a recrudescence of the otitis media, the chemotherapy was resumed. After six days t was a second clinical improvement and again the of sulfathiazole was discontinued. Two days l May 8, the fifteenth day of the otitis media, pa left-sided facial paralysis was evident. There w scanty stringy mucopurulent discharge from a pos superior perforation of the drumhead at this time. tenderness over the mastoid process was elicited. temperature was 99.2 F. One hundred thousand of penicillin was given intramuscularly and in di doses every twenty-four hours until May 12, when use of the drug was discontinued. After three of penicillin therapy the ear had dried. One week its onset the facial paralysis began to improve. W he returned to duty the facial muscles functioned mally and the hearing was 15/15 for whispered v in the affected ear.

E 3.—C. S., aged 19, was admitted to the hos- because of scarlet fever on March 30, 1944. On 7 he complained of pain in his left ear. Exam- n revealed a bulging left drum. His temperature 101.2 F. Myringotomy was done under local esia. Oral sulfadiazine therapy was started that ith an initial dose of 3 Gm., followed by 1 Gm. four hours day and night. The blood sulfadiazine was 4.3 mg. per hundred cubic centimeters on 14. The aforementioned dosage was maintained irteen days. On April 20 the administration of iazine was discontinued because it was considered ctive. The course of the otitis media was unin- ed by it, as was manifested by the continued pro- mucopurulent aural discharge, the continued pain septic temperature, ranging from 97 to 102 F. was no tenderness over the mastoid process. he next six days the patient received no medica-



art showing the temperature curve, the dosage of illin and the time of onset of paralysis in case 3.

A urinalysis April 24 showed albumin (2 plus). is time the red blood cell count was 4,040,000 per millimeter, the hemoglobin content was 80 per and the white blood cell count was 7,700 per cubic meter with 67 per cent polymorphonuclear cells. emolytic streptococcus was isolated from the aural arge. On April 26, the twentieth day of the otitis a, penicillin therapy was started, 20,000 units being every three hours. Three days later complete sided facial paralysis developed. At this time, 29, the ear was markedly improved, with scanty discharge. The temperature was normal. A genogram of the left mastoid process April 30 ed no destruction of any of the cell walls. The ge of penicillin was reduced May 1 and discon- d May 5.

By May 10 the ear was dry, with an intact drumhead. After two weeks of complete facial paralysis the muscles began to regain their functions slowly. Physical therapy was instituted one week after the onset of the facial palsy and was continued until the patient's release from the hospital, June 9, with complete restoration of function.

In these cases the onset of the facial palsy was on the sixth, the fifteenth and the twenty-third day of the otitis media, respectively. The paralysis lasted for eleven, seven and twenty days, respectively, before improvement occurred. Recovery from the otitis media preceded improvement in the facial paralysis. The patients in cases 1 and 3 received physical therapy. This consisted of heat (infra-red rays), galvanic stimulation, facial massage and facial exercises.

SUMMARY

In 3 cases of facial palsy in the course of acute otitis media the progress under conservative medical treatment was satisfactory. One patient received sulfadiazine alone. Two received penicillin in addition to the sulfonamide compounds. In 1 case the paralysis developed three days after the administration of penicillin was begun and after marked clinical improvement had been manifested. The return of function for hearing and facial motion was complete in all cases.

CONCLUSIONS

1. The treatment of facial paralysis in the course of acute otitis media may be nonsurgical provided that the otitic infection can be controlled by vigorous conservative medical therapy in the form of treatment with the sulfonamide compounds and/or penicillin.

2. Recovery from the facial paralysis is dependent on immediate control of the otitis media.

3. The trend toward conservative treatment of otitic facial palsies will be advanced by the results of penicillin therapy. The restoration of perfect function in the cases presented warrants the further trial of penicillin in similar conditions.

Acknowledgment is here made to Major Egon V. Ullmann, Medical Corps, Army of the United States, chief of the Eye, Ear, Nose and Throat Clinic at the Station Hospital, for his cooperation and advice in the writing of this article.

Progress in Otolaryngology

Summaries of the Bibliographic Material Available in the Field of Otolaryngology

FUNCTIONAL EXAMINATION OF HEARING

ALFRED LEWY, M.D., AND S. L. SHAPIRO, M.D.
CHICAGO

The dearth of literature from Europe is compensated for to a small degree through the ability of one of us (S. L. S.) to translate from the Spanish and the Portuguese of South America. The rehabilitation program of the military forces has increased the interest in hearing aids. On the other hand, the functional tests of hearing have shown little progress, most research being devoted to other ends. A monograph on audiometry by C. C. Bunch [1] is an exception and is therefore reviewed briefly.

In "Clinical Audiometry" the late C. C. Bunch summarized the results of over twenty-five years' study and research on the subject. The work, a monograph of 186 pages, is an outstanding contribution in the field of audiometry and hearing tests. There are nine chapters under different headings, as well as an appendix embodying the method of evaluating the hearing loss in medicolegal cases recommended by the Council on Physical Therapy of the American Medical Association in 1942. A comprehensive bibliography completes the book.

The first chapter, entitled "The Heritage of the Tuning Forks," is a fairly complete discussion of tuning fork tests. As might be expected from one who had spent a great part of his scientific lifetime working with the audiometer, the shortcomings of tuning forks are given in considerable detail, and the impression is given that the latter can well be dispensed with if one is well versed in the use of the audiometer. Nevertheless, the classic tests as well as some others are adequately described; not included are the new tuning rods by which tones up to c-7 can be tested, and no mention is made of the monochord or the Galton whistle for the same purpose. The work of the British Committee on Hearing Tests and of other investigators with respect to the true meaning of "prolonged bone conduction" is explained. Dr. Bunch's conclusion that the British committee was rather "naive" in recommending a "reasonably quiet" rather than a soundproof room for the Rinne test will not be shared by a good many otologists who believe that it is preci the presence of a certain amount of nois the background that lends to the Rinne much of its usefulness in the diagnosis of duction deafness. In discussing quantit tuning fork tests the author failed to inc methods for obtaining greater accuracy graphic representation by using forks calibr as to the damping constant; he is on much fi ground in stressing that the lack of standa zation both of tuning forks and of the met of using them has been one of the chief rea for the development of the audiometer.

The second chapter contains a precise des tion of a standard audiometer, as well as pict and additional descriptions of a number of l ing models available in this country. Both "sweep range" and the "discrete freque models are discussed, and the usual curves audiograms are explained, as well as the ne sity for the decibel as a standard of meas ment. The author's preference seems to be instruments of the sweep range variety w can also be used for testing with fixed quencies.

The chapter "Technic of Audiometric Te brings out the author's long experience in field. Not only the accepted methods but o useful details and instructions are given. N worthy is the method of examining with sweep range audiometer at a constant inten Much in the way of discussion and gra representation is devoted to normal variati in audiometric results, the difficulty of expr ing these results in terms of percentages and technic and indications for masking the oppo ear during a test. Of interest is the auth use of the "shadow curve" present in unilat deafness when the other ear is not masked a means of detecting malingering.

The chapter "The Sound-Proof Room" essentially a plea for the use of the soundpr room on the well known ground that sli impairments of hearing cannot be detected in other way. Audiograms illustrating this and detailed descriptions of various types soundproof rooms are added. A great deal

1. Bunch, C. C.: Clinical Audiometry, St. Louis, C. V. Mosby Company, 1943.

ulating material is to be found in the chap- on conductive deafness, albeit some of the or's conclusions are controversial. Bunch ws some of the original work by the earlier gists which led to their dictum that lesions e conduction apparatus are characterized by irment of hearing for low tones and cor- y calls attention to the fact that Politzer in ing this statement, which has been so exten- y copied, did not say that loss for high s does not occur. Pohlman, Knudsen, Crowe Baylor and others are quoted to show the rence of opinion which more recent studies, icularly those with the audiometer, have ght about with respect to this question. ch's own experiments on the basis of plug- the external canals with various substances, ell as cases of bony atresia of the external l and clinical studies of various inflamma- s of the middle ear, lead him to the opinion not only is there always loss of high as well f low tones in conduction deafness but the er is often more pronounced than the latter. ch holds that the reason for the discrepancy he conclusions between the results indicated n tuning forks are used and those shown by audiometer is that the intensity of sound duced by low pitch forks is much less than emitted by high pitch forks and that there- they are heard more poorly than high s. Two comments might be made regard- his thesis: first, that studies of lesions he conduction apparatus which have been e by German observers with audiometers ing loud speakers rather than telephone re- ers (Sonntag; Ruf; Langenbeck) do show y results analogous to those obtained with ing forks; second, that regardless of the dity of Bunch's thesis, tuning fork tests do valuable information in the qualitative diag- s of conduction deafness.

he chapter "Perceptive-type Deafness" in- es a wealth of material on progressive, ilial, traumatic, senile and occupational im- rment of hearing. Most of this work has n established by Bunch and others in peri- al literature.

he last three chapters are perhaps the most resting and instructive in the book and of nselves furnish a good reason for its pur- se.

hapter 8, entitled "The Use of the Audi- ter in Selecting a Hearing Aid," contains a t deal of detailed information on the sub- which does not lend itself to abstracting. ch practical information on how to pick hear- aids for different types of deafness, with the plification curves of several cases, is given.

Chapter 9 deals with the use of residual hearing. The author makes the point that while many deaf-mutes have long been known to possess residual hearing which could be utilized for educational purposes, audiometric tests give a considerably larger percentage than the one third (of all deaf-mutes) found by Bezold to possess usable hearing. Representative audiograms, articulation tests, the relation of vowels and consonants to tonal frequencies and representative cases illustrating how residual hearing has been used for purposes of education are given in detail.

The last chapter dealing with the development of the audiometer contains accounts and illustrations of many early models beginning as far back as 1878 with the one invented by Hartmann, which used an induction coil and telephone receivers. To Americans who are accustomed to consider the audiometer as an American invention it may be somewhat disconcerting to see the large number of German, French, Italian and other devices antedating their own. However, the first audiometer of the vacuum tube type to be produced commercially was the Western Electric 1-A, produced in this country. A rather noticeable omission in the chapter is the German otoaudion, an instrument of the vacuum tube type, first presented by Schwartz in 1920 and employed with either a loud speaker or a telephone receiver, which has received considerable use on the continent.

After referring to the many tests made in public schools, indicating that about 3 per cent of children are handicapped by hearing losses, and criticizing the inadequacy of the group audiometer and the monitor method for testing very young children, particularly as these means do not disclose a loss for high tones, which may be the first indication of developing deafness, Hughson and Thompson[2] insist that discrete frequency audiograms be used for accurate appraisal. They recommend the program sponsored by the American Academy of Ophthalmology and Otolaryngology through its Committee for the Prevention and Conservation of Hearing. In very young children deafness may be mistaken for mental retardation and a great injustice done. Any 2 year old child in whom speech has not developed should be suspected of having impaired hearing. The child of preschool age should be exposed to the audiometric range of pure tones through a loud speaker at about 60 decibels above the normal threshold. There is no fixed pattern of response, but a reaction

2. Hughson, W., and Thompson, E.: Audiometry in the Diagnosis and Treatment of Deafness in Children, Ann. Otol., Rhin. & Laryng. **53**:480 (Sept.) 1944.

to the stimulus can be easily recognized. In normal children it is immediate and unmistakable. In the deafened child there is some change of expression or focusing of attention. In the presence of a noise stimulus of a broad frequency band, a thermal hiss in measured intensities of 5 decibel steps, a normal child reacts promptly. The reaction of a child with impaired hearing manifests itself at 20 to 60 decibels above the normal threshold. A completely deaf child does not react at 100 or more, which approaches the level at which pain is felt in the normal ear. In less severe cases the audiometric receiver may be held to the child's ear by an assistant. A high percentage of children with palsies referable to lesions of the brain have defective hearing. The history must be taken and a clinical examination made preliminary to treatment. Reasonably accurate tests may be made from the age of 2 years upward. Tests for reception of speech are valuable in regard to primary school children. In this the game factor is an incentive.

The balance of the article is concerned with prevention and therapy.

Vastine,[3] working at the Pennsylvania School for the Deaf, studied the correlation between the function of the vestibular system and the hearing in very deaf children, using the Bárány caloric technic; 408 ears in 208 pupils were tested. Complete loss of vestibular function was rare; function was subnormal in 57 per cent, normal in 24 per cent and absent in 19 per cent. A decrease in activity paralleled the decrease in activity in the acoustic function except when it was due to meningitis, in which case the static division of the labyrinth was partially or completely inert. In children with congenital deafness neither the response of the static nor that of the acoustic division showed as severe damage as in those with acquired deafness. A type audiogram can be drawn corresponding to the vestibular activity. Fifty per cent of ears with a normal static division of the labyrinth responded to the first five audiometric frequencies, not to the two highest; those with a hypofunctioning one did not respond to the highest three; the majority with an inert one did not respond to the last five.

In an article on head noises in normal and in disordered ears Fowler [4] describes his method of measuring the intensity of the tinnitus by comparing it with the same frequency measured in the opposite ear. In the case of neural deafn in which the recruitment phenomenon may in fere with the test, masking may be used.

The functional findings in ears submitted acoustic trauma are discussed by Schmalix.[5] calls attention to worldwide recognition of subject and makes a comparison of indust and aviation deafness. Thirteen flight instr tors examined by means of serial forks sho shortened perception for c-4 and c-5 forks loss of hearing for the whispered voice, w on the left side. Flight students examined be and after a few hours of flying were exami audiometrically. Most of them showed lo above c-4 in the form of dips or of a gen depression. One had an aggravation of a existing deafness of the inner ear. Six instr tors showed loss for middle and low tones addition to loss for high tones. Two of th were examined shortly after a flight. Schm concludes that the fact of the development inner ear deafness through a chronic effect noise is established. It will be interesting observe further developments as to the f and the degree of this deafness.

Smith [6] reports a patient who could vol tarily contract the tensor tympani muscle. audiometric findings were a loss of 40 decibels 128 double vibrations decreasing to normal 2048, with another dip in one ear at 3072 in the other ear at 4096. At the two latter po the loss was greater with mild than with contraction. In common with many other oto gists, Nemirovsky [7] believes that every hum being on arriving at a certain age pres acoustic changes which in time progress to deafness. There is, however, considerable diff ence of opinion as to the age when such imp ment first manifests itself. Most obser believe that a diminution of 1 decibel for e year, particularly for the higher tones, is ma fested by persons over 30. Iver and Barrat even further and claim that auditory acuity high tones begins to diminish after the age of Their investigations showed that fully a third young people between 21 and 22 demonstrate loss of 10 decibels for 4096 double vibrati and 20 decibels for 8192 double vibrations.

Nemirovsky states that he has noted un plained reductions of hearing for these two to in medical students between the ages of 19

3. Vastine, M. F.: Correlation Between Vestibular Function and Hearing in Profoundly Deaf Child, Arch. Otolaryng. **39**:164 (Feb.) 1944.

4. Fowler, E. P., Jr.: Head Noises in Normal and in Disordered Ears, Arch. Otolaryng. **39**:498 (June) 1944.

5. Schmalix, J.: Inner Ear Trauma by Aerop Noise, Luftfahrtmedizin **8**:368 (Feb.) 1944.

6. Smith, H. D.: Audiometric Effects of Volunt Contraction of the Tensor Tympani Muscles, A Otolaryng. **38**:369 (Oct.) 1943.

7. Nemirovsky, S.: The Audiometric Picture Senile Hypacusis, Rev. otorrinolaring. d. litoral **2** (Dec.) 1943.

His investigations indicate that these reduc-
ns in young people progress slowly but are
ject to physical and social factors.

The anatomic basis for senile deafness was
monstrated by Saxen, who made a careful
laryngologic study of 200 old people under
care. Of these, 44 came to autopsy, and
showed well defined senile changes in the
itory apparatus; among the latter were 13
h senile atrophy of the cochlear ganglion, 19
h arteriosclerotic changes in the internal ear
1 with central cochlear involvement. The
diometric curve in cases of senile deafness,
ile not characteristic for that type of deafness
ne, always showed involvement of the right
e of the audiogram with both air and bone
duction. The comparison between the curves
the two ears indicates that while they possess
same general characteristics, they can seldom
superimposed on each other but demonstrate
ne differences depending on degrees of
iness.

Wilson [8] comments on the fact that loss of
aring due to acoustic trauma is not susceptible
treatment and that therefore prevention is all-
portant. The literature on the subject is thor-
ghly reviewed. Methods of prophylaxis fall
o definite channels. The most familiar ones
devices for plugging the external canals,
rying from the simple use of cotton, with or
thout the addition of some viscous substance,
different contrivances made of rubber or of
stic material; pads and helmets such as avi-
rs use are also of value. All these means
ve limited application in that they will not
ep out more than 25 decibels and are objec-
nable for the reason that they cause some dis-
mfort and inconvenience, particularly as they
ake conversation more difficult. Another ap-
oach—the elimination of noise at the source
substituting welding for riveting and simi-
procedures—is unquestionably the ideal
proach, but its attainment is as yet far off.
Vilson has taken advantage of the opportunity
forded for testing men in the army both before
d after they have been exposed to noise from
fle and pistol fire to carry out a test first sug-
sted by Peyser. This consists in taking two
reshold values for the frequency of 256 cycles,
ne before and the second thirty seconds after
80 decibel tone at that frequency has been
plied for five minutes. The object is to find
ose men who have a definite lack of resistance
loud sounds, indicated by a rise in threshold
over 5 decibels after stimulation. A number
of otologists since Peyser have conducted similar experiments but, as Wilson remarks, none have attempted to establish the validity of their results under actual industrial or military conditions. Wilson made Peyser's test with a series of 85 men, all carefully studied for any factors which might obscure the results. Twenty-seven men showed abnormal fatigue, and 58 did not; all 85 were later exposed to given periods of noise on the firing range under similar conditions. Subsequent to the exposure audiometric studies showed that of the 27 men who were considered susceptible, 21 showed hearing losses while of the 58 insusceptible soldiers, only 10 were affected. Wilson considers that his results clearly point to the value of using Peyser's test or some similar method of screening out susceptible persons from occupations in which noise is an important element.

Profound loss of hearing in one ear, Hughson [9] states, is a difficult problem from the diagnostic and the prophylactic standpoint. The patient's margin of safety is greatly reduced. The single good ear is more easily masked by extraneous noise. There is confusion in group conversations. The location of the source of the sound is difficult. Speech and sounds on the deaf side may be entirely missed. A loud tinnitus, if present in the deaf ear, may mask hearing in the good ear to some extent.

Study of loss of hearing caused by the following conditions was made in the course of an analysis of 1,400 cases in which there was unilateral hearing loss ranging from slight to complete:

1. Local infection: The therapy is specific.

2. Toxic involvement resulting from acute streptococcic infection of the nasopharynx. The acoustic branch of the labyrinth is almost always affected; the static division, not necessarily. Recovery seldom takes place. The involvement of the labyrinth will probably persist for some time.

3. Trauma: A fracture through the ear with escape of cerebrospinal fluid results in destruction of both the static and the acoustic division of the labyrinth. Blast injuries are usually bilateral. This acute type of hearing loss is most devastating from a psychologic standpoint. The acoustic trauma may affect one ear only.

4. Ménière's disease: The effectiveness of conservative therapy can be gaged well by the audiometric study as well as by the relief of symptoms. Few reports of the effect of therapy have been controlled by this type of examination. Ménière's disease occurs in adult life, and this

8. Wilson, W. H.: Prevention of Traumatic Deafness: A Preliminary Report, Arch. Otolaryng. **37**:757 (June) 1943.

9. Hughson, H.: Unilateral Deafness, Laryngoscope **54**:467 (Sept.) 1944.

particular aspect has never been thoroughly explored.

5. Tumor: Tumor of the acoustic nerve and cerebellopontile tumor can be diagnosed in their early stages only by means of the most careful and repeated audiometric studies. After the classic picture develops, they are seldom cured. Every unexplained case of unilateral nerve deafness should have new growth ruled out. In the author's series there were 4 cases of tumor of the brain, in 3 of which the tumor was diagnosed. The 4 patients were operated on, and 1 survived. This patient had a giant cell tumor of the submaxillary fossa.

In a school population of 535 deaf children 5 give histories of bilateral hearing loss developing after mumps. All contracted parotitis before the age of 3. Encephalitis in the course of mumps is frequent. Deafness following mumps is often complete and always irreversible. The static portion of the labyrinth is seldom involved. There are no specific data as to the pathologic changes in the ears in this condition. Mumps may have been subclinical, and this relationship has been investigated by Dr. Enders, of the department of bacteriology of Harvard Medical School. Of 16 subjects available for cutaneous and complement fixation tests, 6 had a positive history of mumps. All special examinations failed to contribute to the diagnosis. Encephalitis with or without clinical mumps may be responsible. Some of those with no history of having had mumps gave reactions characteristic for those who had had this disease. Perhaps some of the sporadic cases of supposedly congenital deafness may have been cases of deafness due to subclinical mumps. Any virus diseases may have a similar toxic effect. Local treatment in these cases is mentioned only to be condemned. A report of a relationship between maternal German measles in early pregnancy and the appearance of embryonic defects in the infant, especially deafness, is extremely significant.

Dr. W. E. Grove discussed Dr. Hughson's paper. The paper, he said, had been stimulating in several directions. The question of how much disability is caused by total unilateral or monaural deafness he found puzzling. That monaural deafness does cause some disability is perfectly true, but it certainly does not cause as much disability as does monocular vision, to use another paired organ of sense as an example. Hughson places the disability at 10 per cent. The table of compensable disability adopted by the American Medical Association fixes it at approximately 12 per cent. In the answers to a questionnaire sent some years ago to otologists all over the country by Austin Hay[illegible] the figures given ranged all the way from [illegible] 50 per cent. However, in view of the fact [illegible] the subjects of such deafness can compensate [illegible] some extent for the totally deaf ear and the [illegible] that although sound travels in a linear direct[illegible] as far as an individual ear is concerned, there [illegible] some reflection of sound from the surround[illegible] surfaces, an estimate of between 10 and 15 [illegible] cent, Dr. Grove said, is probably quite fair.

In making an audiometric test Dr. Hughs[illegible] masks the better ear when the over-all differe[illegible] between the two ears is 30 decibels or m[illegible] Dr. Grove, recalling that Bunch advocated ma[illegible] ing the better ear when the difference betwe[illegible] the two ears exceeded 40 decibels, asked [illegible] Hughson to explain in more detail why he [illegible] chosen the figure 30.

Dr. Grove then took exception to Dr. Hu[illegible] son's statement that "direct physical force [illegible] sulting in injury to the temporal bone w[illegible] bleeding from the middle ear and the escape [illegible] cerebrospinal fluid will result almost inevita[illegible] in complete destruction of the static and [illegible] acoustic labyrinth of the affected ear." His o[illegible] experience with a large number of such injur[illegible] had been just the opposite. In the great m[illegible] jority of cases a fracture of the temporal bone [illegible] a longitudinal one which runs along the anter[illegible] border of the pyramid, crosses through the m[illegible] dle ear and ruptures the membrana tympa[illegible] The meninges may be torn by such a fractu[illegible] resulting in escape of cerebrospinal fluid, but [illegible] otic capsule is not directly involved in [illegible] fracture.

In a survey of 211 cases in which fracture [illegible] the skull was proved to have occurred, publish[illegible] in 1929, Dr. Grove tabulated the hearing los[illegible] of 108 persons with unilateral longitudinal fr[illegible] tures and of 34 with bilateral longitudinal fr[illegible] tures. In this series the hearing was normal [illegible] 8 ears. A slight loss was recorded for 78 ea[illegible] a moderate loss for 69 ears, a marked loss [illegible] 85 ears and a subtotal loss for only 9 ears. [illegible] no instance was there total deafness. The l[illegible] of hearing in these cases was of a perceptive ty[illegible] and was undoubtedly due to hemorrhage i[illegible] the basal coil of the cochlea caused by the co[illegible] cussion of the labyrinth and not by the fractu[illegible] per se. Of course, Dr. Grove said, when [illegible] deals with a transverse fracture which cros[illegible] the pyramid and opens the otic capsule, t[illegible] picture as to total destruction of the static a[illegible] acoustic divisions of the labyrinth is exactly [illegible] Dr. Hughson has painted it. Fortunately, th[illegible] transverse fractures are rare.

In Ménière's disease, he stated, the unilate[illegible] deafness varies greatly from time to time. H[illegible]

is dealing with hydrops of the labyrinth, h may vary in intensity from time to time. n the pressure is acute, the hearing loss will naximum. When it subsides, the hearing improve. The end picture is that of a high ee of unilateral deafness.

he auditory nerve is probably the most erable of all cranial nerves to such general systemic diseases as typhoid, scarlet fever, sles, diphtheria, influenza, syphilis, leukemia, icious anemia and diabetes. Politzer com- ted on the fact that a large number of cases umps had been reported in which the func- of the auditory nerve was quickly arrested in which complete deafness followed.

hat unilateral deafness occurs in all of these emic conditions, Dr. Groves said, cannot be ed, and its occurrence following one of these e or less general systemic conditions has ys intrigued him. That the hearing loss wing mumps is "most frequently unilateral" matter to which his attention has not been icularly drawn. It may be so, he said. It is known that the virus of mumps attacks most he tissues of the body and frequently causes ingitis of a mild or a severe degree. If the ness were due to this meningoencephalitis, would expect it to be bilateral in the ma- y of the cases. Therefore, Hughson's mption that the virus itself directly attacks neural mechanism of one or the other stic nerve is probably well taken.

n this connection Dr. Grove mentioned that Max Fox, the epidemiologist of the Con- ous Hospital of the Milwaukee Health artment, who has written the article on epi- ic parotitis which will soon appear in the edition of Tice's "System of Medicine," ed that he had never observed deafness, er unilateral or bilateral, caused by mumps. Grove said that this observation by one who careful clinician, makes him wonder whether deafness which has been ascribed to mumps in reality due to that condition.

Dr. H. I. Lillie also discussed the paper by Hughson. His observations had been di- gent from Dr. Grove's. While he was serv- to control contagious diseases at the Uni- sity of Michigan there occurred an epidemic mumps, and overnight many of the victims e unilaterally deaf. In examining any uni- rally deaf patient he always inquired if the ent had had mumps. He was convinced that mps may be the cause of complete unilateral ness.

Dr. E. P. Fowler expressed the opinion that balance test is valuable in proving total uni- ral deafness. No matter how high the ob- server raises the loudness, there will be no change in the relationship between the loudness required to balance because one ear will be hear- ing all the sound. The other ear will give a "shadowgram."

Tinnitus, he said, is usually not as loud as the patient says it is. Give him a similar sound and balance with the tinnitus. Tinnitus is caused by irritation of the neural element. It gives the sensation or illusion of sound. Dr. Fowler did not think there could be tinnitus in any fre- quency range without some deafness in that range. He pointed out the relationship of tinni- tus to the masking effect on the good ear. This is not the mechanical effect of the tinnitus as such; it is due to the nonfunctioning of the nerve elements whose injury is causing the deaf- ness and the tinnitus.

Dr. H. Marshall Taylor asked Dr. Hughson if he had ever seen unilateral mumps followed by deafness on the other side. He wondered if a patient could have anoxemia or swelling of the nerve head similar to that with Bell's palsy and cutting off of the blood supply, which is a rare sequel of serum sickness. He had seen 2 cases of unilateral deafness from mumps and the deaf- ness was on the side opposite the mumps.

Dr. Burt R. Shurly said that in the last war a hospital at Vitré, France, opened with 400 cases of mumps. In none of the patients did deafness develop but many had orchitis or epi- didymitis. In the Spanish War he was con- nected with two hospitals where there were 3,000 patients with typhoid fever, something that would never be seen again in the history of medicine, he thought. Aural symptoms were practically absent; there were occasional laryn- geal developments. The point he made was that in thousands of infectious diseases this phe- nomenon (unilateral deafness) is quite infre- quent.

In closing remarks Dr. Walter Hughson said in reply to Dr. Grove that the latter's obser- vations were associated with skull fractures in industrial accidents, while his referred to direct trauma of the ear. Perhaps, he said, the frac- tures he had observed were transverse fractures. In Ménière's disease normal variation shades the effect of therapy. Few cases had been reported in which careful audiometric studies had been made. He pointed out that by care- ful audiometric tests one can anticipate begin- ning remissions or exacerbations better than one can by subjective symptoms and that thus an exacerbation may be aborted if taken early. He had never seen a case in which he could attribute unilateral deafness to syphilis, and rarely bilat- eral deafness. Dr. Grove's experience and that

of his colleagues regarding mumps and deafness would indicate that the relationship is unusual. He stated that he and his co-workers were reporting 6 cases of direct association of unilateral deafness and mumps. However, they had 10 unexplained cases, and he was presenting this possible explanation. In reply to Dr. Lillie he thought that perhaps the epidemic of unilateral deafness had to do with virulency of the particular virus. "So far I know of no similar incidence as the result of epidemics reported by the Army Commission on Contagious Diseases." He thought the pathologic changes would be demonstrated only as atrophy of the neural mechanism of the ear, which has been demonstrated in many other cases of unexplained cause.

In reply to Dr. Fowler, who questioned his statement that in complete unilateral deafness the loudness balance test is not of importance, he said that of course complete unilateral deafness is perceptive in character. The present study concerned only the deafened ear in the patient whose other ear is normal. Were a bilateral loudness test done in a case of complete unilateral deafness, incorrect results would be obtained. The shadow curve which is obtained in the audiogram, unless masking is used, would also be present in the loudness balance test. Because of this cross over effect, a constant type loudness balance curve is obtained which is just as inaccurate as the shadow curve on the audiogram. Consequently, in complete unilateral deafness with the hearing in the opposite ear normal a loudness balance test is of no diagnostic value.

He cited an audiogram of a patient who had complete unilateral loss of hearing and a loud constant roaring tinnitus. The otic capsule had been destroyed by a tumor. The tinnitus was somewhere else. It masked the normal ear in quiet surroundings.

In regard to unilateral deafness with unilateral mumps, one patient had the mumps on the contralateral side. Dr. Hughson said that Dr. Shurly had reported 400 cases of mumps without any deafness but with some orchitis. He wondered if the hearing loss may have gone unobserved because of this uncomfortable complication.

Goldman [10] states that he has had the opportunity to study a large number of audiograms of Army Air Forces personnel and to compare them with the results of whisper tests and of low conversational voice tests. The comparison revealed that "there was no constant correla between the audiometric average decibel loss the recording of the whisper perception or conversational voice test."

Both audiometric and whisper examinat were made routinely on a total of 167 men. average decibel loss for 256, 512, 1024 and double vibrations, "which tones are suppose include the speech range," was computed. acuity of hearing for the whispered voice determined by the method prescribed by War Department. The cases of deafness classified as (1) nerve type deafness, (2) duction type deafness, (3) mixed type deaf (4) deafness associated with otitis media, deafness following injury or specific dise (6) deafness following mastoidectomy and otosclerosis.

Series of cases are reported showing gra cally the inconsistency between the loss as m sured in decibels and the loss as measured perception of whisper. As a result of the st of these data, the author believes that the hu voice still offers the best means of determin acuity of hearing for speech. He does not tend that it presents the most accurate me of interpreting man's hearing. Audiograms great aid in the diagnosis of different types hearing impairment, a permanent record of h ing and a record of variations over a pe of years. With flying personnel they are value in detecting evidences of nerve deafnes the early stages.

It is suggested that otologic surgeons forming the fenestration operation may valuable information in their reports of proved hearing by accompanying their au grams with records of whisper and con sational voice tests.

Dr. Robert J. Hunter, discussing Col Goldman's paper, said that there is a great dif ence in examining military personnel and civi personnel.

> One reason is [he said] that candidates often do know what the answer should be and form an opi according to the distance of the examiner. If I ge inconsistent answer, I check with the audiometer masking. I want to use the Bárány buzzer, the Ste test and the Lombard test. If these correspond I c sider the answer correct. I want to do the audiom tests myself on one which I have personally standa ized on people with supposed normal hearing. M shows a little dip at 512, and if I get such a read I know the answer is honest. I also like to take a on myself to estimate the noise level as measured aga my own hearing, which I know. In my private prac I use the whispered voice. In the Navy the low spo voice is used, and I have been impressed by how c sistent they have been.

He asked if Colonel Goldman did all th tests on a personal basis.

10. Goldman, J. L.: A Comparative Study of Whisper Tests and Audiograms, Laryngoscope **51**:559 (Oct.) 1944.

ptain Raymond Truex said that with 650
nts he and his colleagues found no corree-
n with what these patients said in the past
rding their hearing. Each patient now has
udiometric study in a soundproof room, and
rrelation has been noted with the whispered
poken voice test as described in the Army
ual. The tests are done by well trained men.
find 6 and 7 feet difference between two
rs in twenty minutes between tests," he said.
r. Edmund P. Fowler asked what else was
matter with these men besides their hearing.
gard to those who were equally deaf in both
and whose hearing perception of whisper
esponded with the audiogram, he suggested
the bilaterally deaf are adapted to faint
ds. They know how to listen. He added
the whisper is a test for itself only. It is
a test for the modulated voice, nor is the
iometer. They are different methods of
ng, and they test for different things.

Many factors enter. Environmental noise
cts the patient's hearing and also the ex-
ner's voice. This is quite unavoidable. The
stics of the room, the reflection from the
wall, the failure to close the good ear per-
y, all affect the test. The masking may be
little or too much. It should be just suffi-
t to cut out the testing sound in the other ear.
n bilateral difference in hearing, the poor ear
psychologically shut out. If the hearing is
l in the two ears, both are used. Attention
cused on the good ear. It makes a difference
he patient is accustomed to the tester's voice
whisper, and his education, his intelligence
tient and his attention also contribute, so that
matter what other tests are used the audi-
eter should be the basis for one's estimate.
f complete audiograms were made, not only
h threshold but with above threshold intensi-
, then with proper thought and work otolo-
s could correlate the audiogram with the
ent's capacity to hear almost anything he
nts to and so determine the capacity of his ears.
Dr. LeRoy M. Polvogt recalled that Colonel
dman interprets all the audiograms with loss
high tones as representing nerve deafness.
asked about the nasopharynx in patients with
h losses. Were they all fliers? Their com-
n complaint is obstruction of the eustachian
e, in which condition the first tones lost are
high ones. He also wished to know if all
tests with whisper were made by the same
rson.

Dr. Jacob L. Maybaum asked: "Were these
ts repeated or done only once for each indi-
vidual?" He tried the whisper test on 2 persons who had undergone the fenestration operation eight months and fourteen months earlier, both of whom heard a whisper at 4 feet (1.2 meter) before operation. The first heard the whisper at 18 feet (5.5 meters); the second, at 20 feet (6 meters). The latter had a decibel loss of 60 before operation. Another, operated on by Dr. Lempert, heard the whisper at 3 feet (0.9 meter) and now at 18 feet (5.5 meters). There was no audiogram for this one. "This paper," said Dr. Maybaum, "certainly convinces me that we have no adequate hearing test for accurate evaluation of hearing. Dr. Fowler said the audiometer determines the capacity for hearing. It does not tell how one can interpret speech." He expressed the belief that light could be thrown on that from the improvement following fenestration as shown by the tests now at one's command, particularly the audiometric test in relation to the whisper test. Variable as the whispered voice is, it gives an indication of the improvement.

Closing the discussion, Colonel Goldman said that every patient in his series had a complete examination of the upper respiratory tract. There was no tubal obstruction or pathologic change of the nasopharynx. Otosclerosis was diagnosed on the history, the hearing and the results of examination of the middle ear. All were tested by himself and a well trained technical sergeant under his direct supervision, as carefully as they could be in private practice. "Of course," he stated, "there is the individual factor of myself." Tests were repeated when necessary. In a few instances there were psychogenic factors. The audiometer was frequently checked on normal subjects. Much has been written on this subject, largely in the nature of theoretic explanations. In the army one is confronted with the need to make important decisions on hearing tests quickly and often. He felt that he expressed the opinion of his colleagues that the present tests are inadequate to gage a man's hearing perception. That is the practical significance of his paper. He concluded:

> We need a definite program to improve hearing tests. We must determine if a man can hear signal code, radar beams, et cetera, and we have no tests available for these specialized sounds. This is being presented as a factual report; I feel that I am an amateur in this field compared with the men present, but I have been impressed with the lack of tests available for the purpose of my work and would like to hand that information on.

Pitman[11] describes a device for "detecting simulated unilateral deafness." A common

11. Pitman, K.: Device for Detecting Simulated Unilateral Deafness, J. A. M. A. **121**:752 (March 6) 1943.

stethoscope is attached to the patient's ears with the bell behind his back. A two way petcock is fitted to tubes A and B. The bell is attached to the far end of A; a Bárány noise apparatus, to B. When the petcock is turned clockwise, speech is carried only into the right ear and noise into the left. The procedure is now reversed and speech is carried into the left ear and noise into the right. The subject's bewilderment is shown by his responses.

Smith [12] measured bone conduction during fixation of the stapes. He used cats, fixing and releasing the stapes by a thread and measuring the hearing by the cochlear response. He noted a definite reduction of hearing for frequencies from 500 to 1500 double vibrations by bone conduction when the stapes was fixed. This he ascribed to inertia. In 15 tests on 8 ears he found that when the fixation was sufficient to reduce profoundly the cochlear response to air conduction, the response to bone conduction in the frequencies from 500 to 1500 was substantially reduced also.

Malis [13] made a survey of hearing in the Los Angeles parochial schools. Testing was done on 2,567 children, 5 to 16 years of age, with a pure tone audiometer. Around 20 per cent of the children were found to have impairment of hearing. It is pointed out that this method is superior to the usual phonograph speech method of mass testing which has been in vogue for about fourteen years. With the latter method various observers have found impairment in about 6 to 9 per cent. The author feels that the difference in the incidence of impaired hearing as noted with the two methods is due to the fact that with speech tests impairment of hearing for high tones is likely to escape detection.

Montandon [14] reports on a new radioelectric audiometer which was built according to his specifications by the Viennaphone Company, Vienna, Austria. This instrument has a range of 25 to 22000 cycles, is of the pitch range variety, which enables any tone to be tested but is also graduated in octaves from 32 to 16384, so that testing at octave intervals can be done. The intensity is measured in decibels. The instrument is now in use at Montandon's otologic clinic at Geneva, Switzerland. It is described as of high precision and easily managed. He states that it will be put on the m in the near future.

Bloomer [15] presents a method of testing ing which can be used with the majori intelligent children 3 to 5 years of age who sufficient usable hearing to respond to v direction. The equipment consists of a tone audiometer and several white cards, 8 11 inches (21.5 by 28 cm.), on which have drawn or pasted colored pictures of ob which the child normally associates with production of some sound and which ar interest to a small child—pictures of trains planes, birds, Indians, lambs and so on. best pictures are those which show an ar "talking" to a person or to another an There is but one picture to a card. The ture is shown to the child, and he is told the doctor is going to let him hear the sing, the train whistle and so on. The ear is then held to his ear, and he is allowe hear a tone appropriate to the object, e. low-pitched tone such as c-256 with the pi of a train or a high-pitched one such as c- for a bird. It is then explained that he stop the sound by putting his finger over whistle of the engine or the mouth of the He is to touch the bird or the train as soo the sound is made and to lift the finger as as the sound is interrupted (by the examin The author advises giving a partial test of more than four frequencies at a time bec of the difficulty of keeping the child inter for more than fifteen to twenty minutes.

The Mazzas [16] stress the value of tuning for qualitative diagnosis of hearing defects thr the use of such standard tests as the Weber Rinne and the Schwabach, contending inasmuch as the decibel is the accepted scien criterion for measuring the intensity of so all that is necessary in order to use fork measure hearing loss is to adapt them to ordinary audiogram. They mention the pa by Roth and Johnson, published in this cou dealing with graphs made with the use of tu forks, but criticize these as "rudimentary." their method they use the Hartmann serie five forks running from c-128 to c-2048. U the damping constants established by Fowle an identical series, they establish by mean Fletcher's formula hearing losses (t°—t) equivalent in seconds of the extreme limit decibels of hearing loss as shown in the u

12. Smith, K. R.: Bone Conduction During Experimental Fixation of Stapes, J. Exper. Psychol. **33**:96 (Aug.) 1943.

13. Malis, S.: Individual Audiograms Versus Mass-Testing as a Means of Detecting Hard-of-Hearing, J. Internat. Coll. Surgeons **5**:498 (Nov.-Dec.) 1942.

14. Montandon, A.: Un nouvel audiomètre radioélectrique, Confinia neurol. **4**:356, 1942.

15. Bloomer, H. A.: A Simple Method for Te the Hearing of Small Children, Quart. J. Speech **28** (Oct.) 1942.

16. Mazza, A., and Mazza, N.: Grafico audiome pelos diapasões, Rev. brasil. de oto-rino-laring. **10** (Nov.-Dec.) 1942.

stern Electric audiogram. These were found e as follows:

uency.....	128	256	512	1024	2048
ometer (decibels)	94	105	115	120	120
ng fork (seconds)	87	77	88	88	56

vertical lines on the audiogram correspond- to the frequencies shown here are then ded into equal segments corresponding to second intervals, with the exception of the segment which represents the remaining tion; the usual normal line at the top is med.

Certain criticisms or comments on the method uld be stated. One, given by the authors nselves, is that the audiogram is limited to five frequencies mentioned; this can be edied by using additional forks. The authors arently were content to accept Fowler's cali- ion for his series of similar forks. As s notably differ in quality and rate of de- ment even when they are of the same make, hould be stressed that if accurate use of this hod is desired, calibration of the individual s by an accepted method is necessary. It uld also be stated that the figures for extreme ring loss calculated by the authors are strictly oretic, as for some of the frequencies given g., 2048) no tuning fork made at present l emit a sound which lasts as long as the re (in seconds) given in their calculations.

A series of 1,365 school children, 8 to 14 years age, was studied by Loch [17] for two years to the presence and permanency of tonal s. The tonal dip was defined as a depression tones 512 to 4096 of at least 15 decibels or re below the average of the audiogram. For quencies higher than 4096 or lower than 512, threshold for the next higher or lower tone d to be at least 40 decibels better than that the frequency at which the dip occurred. resholds were determined for 14 frequencies tween 32 and 16384 in a soundproof room.

It was found that dips occur about three times often in boys as in girls and that the older ildren of both sexes showed more dips than younger ones. About half of all dips were the frequency of 4096 cycles. Industrial ise, stated by some writers to be a factor in nilar studies made on adults, evidently is not cause here, and the difference in incidence tween males and females must be regarded as true sex difference. Persistent dips were found ost often for the frequency of 4096; about o fifths of all dips proved to be permanent. uring the period of observation the greater increase in dips for both sexes was at the frequency of 10321 cycles.

Relationships were sought but not found between tonal dips in children and the following items: previous tonsillectomy and adenoidectomy; previous otitis media; common colds; the appearance of the membrana tympani; the condition of the nasopharynx; the season of the year.

The author reviews the older hearing tests and makes the point that while the audiometer furnishes a more exact means of studying impairments of hearing for pure tones, the degree of impairment indicated by the audiometer does not necessarily correspond to that for speech. Kinney [18] cites cases from his own practice in which little improvement in hearing for pure tones but considerable improvement in hearing for speech followed inflation; on the other hand, he has observed cases in which hearing for speech was impaired although there was no loss for pure tones. In connection with these observations he cites 2 instances in which a fenestration operation performed by another otologist was followed by a hearing improvement much greater than could be demonstrated with the audiometer. His conclusions are:

1. Official standardization as to the point of recording hearing decibel loss should be adopted.

2. A person cannot hear pure tones binaurally any better than he can in his better ear.

3. A person can hear the spoken voice better binaurally than he can in his better ear providing there is a bilateral impairment.

4. The American Medical Association's adopted method of determining percentage hearing loss is far superior to any method previously adopted. Because more weight in the determination of the figures was given to the laboratory analysis rather than to clinical experience, the American Medical Association's method is inaccurate in the following cases:

A. Cases of so-called otosclerotic type in younger persons where the pure tone loss is much greater than the voice loss.

B. Cases of unilateral nerve deafness type where the ability to perceive speech is practically nil while they [the patients] still have some ability to perceive pure tones.

5. While ability to perceive and analyze essentially pure tones may lie completely in the cochlea, ability to perceive and analyze more complicated tone patterns in the form of human speech probably lies more centrally and has a bilateral innervation.

6. More accurate methods of estimating one's ability to perceive speech must be developed before true analysis of hearing loss can be accurately determined.

7. When these better methods are developed and a better understanding of the central connections of the eighth nucleus are made, some of the newer therapeutic methods for improving an impaired hearing will be more readily evaluated.

17. Loch, W. E.: Incidence and Permanency of Tonal ps in Children, Laryngoscope **53**:347 (May) 1943.

18. Kinney, C. E.: Interpretation of Hearing Tests, Laryngoscope **53**:223 (April) 1943.

Kobrak, Lindsay and Perlman [19] studied the influence of a masking tone on hearing sensation and the acoustic middle ear reflex. Masking sounds were produced either as pure tones or noises by an audiometer as well as by the Bárány noise apparatus and other sources. The subjects were rabbits in which the tensor and stapedius muscles were exposed under light narcosis, as well as a number of patients in whom the contractions of the stapedius muscles could be observed through a perforation or a scar. Their conclusions were as follows:

1. The acoustic reflex of the tensor tympanic muscle in the rabbit is unchanged in the presence of typical noise background of a room.

2. The acoustic reflex of the tensor tympani muscle in the rabbit remains unchanged when a masking tone is sounded which is below the tensor threshold.

3. If the masking tone is above the tensor threshold the acoustic tensor contractions are superimposed on the tensor. The threshold is raised.

[As their fourth conclusion the authors state that in the human being masking causes a dip in the hearing sensation without affecting the stapedius threshold.]

5. The absence of a masking effect on the reflex is interpreted [to indicate] that masking originates outside the part of the acoustic system in which hearing sensation and reflex response are together. [The authors state that there are two possibilities.] First is the possibility that the masking effect originates in the central nervous system above the level of the reflex or apart from the fibers of the reflex arc. A second possibility is that the masking effect originates in a different part of the cochlea. . . .

6. [The experiments indicate] that the mechanical stimulation of the cochlea is undiminished in the presence of a masking tone.

7. Since both reflex contractions and cochlear potentials are unchanged, the origin of masking is most likely not in the peripheral sense organ.

Politzer and others have made the comment that contractions of the tensor tympani muscle diminish the distance of hearing and reduce especially the hearing for low tones. Smith [20] reports his observations on a lieutenant who was able to contract his tensor tympani muscle voluntarily, this being visible by otoscopic inspection. The subject first discovered that he could perform this feat at about 8 or 9 years of age. The maneuver produced a low-pitched roar in both ears and diminution in hearing sufficient to block out ordinary conversation, and he could maintain a steady contraction of maximum intensity for twenty or thirty seconds. Then the muscles would have to be rested for ten or fifteen seconds before they could be contracted again. Audiograms were made of his hearing [illegible] ordinary circumstances and during contra[illegible] of the tensor tympani. The curve for hea[illegible] during the contraction indicated a loss w[illegible] was greatest at 128 double vibrations (the [illegible] jective roar corresponded to a tone just a[illegible] 64 double vibrations) and gradually dimini[illegible] up to 2048 double vibrations, the hearing [illegible] which was unchanged; there was a further [illegible] smaller diminution for tones above 2048, [illegible] greatest dip being at 4096 double vibrati[illegible] Smith comments on the controversy regard[illegible] the effect of middle ear processes on the typ[illegible] hearing loss and suggests that his observati[illegible] may be of some value in the interpretation [illegible] certain audiometric records inasmuch as occ[illegible] sion of the eustachian tubes causes a retract[illegible] of the tympanic membranes which places [illegible] aural conduction mechanism in a condition so[illegible] what similar to that produced by contraction [illegible] the tensor tympani muscles.

Perlman [21] attempts to revise the conventio[illegible] ideas regarding conduction deafness in the li[illegible] of experimental work done by European [illegible] servers in recent years. He states that the [illegible] teaching that loss of hearing acuity for l[illegible] frequencies means a lesion of the conducti[illegible] apparatus and loss for high frequencies a les[illegible] of the acoustic nerve is incorrect as demo[illegible] strated by experience with the audiometer, t[illegible] ing fork tests and loudness balance studies. [illegible] cannot predict the character of the audiogram [illegible] objective examination of the ear, because it [illegible] not known what the various components of t[illegible] conducting apparatus contribute to the hear[illegible] curve and it is impossible to visualize more th[illegible] a small portion of the middle ear structures th[illegible] are concerned with sound conduction. Studi[illegible] on animals are handicapped by the lack of pe[illegible] fect methods for testing auditory function [illegible] animals, and the difficulty of applying acous[illegible] physics to such studies further complicates t[illegible] problem.

Perlman nevertheless concludes that a go[illegible] deal of information on this subject can be o[illegible] tained by observing the alterations produced [illegible] normal audiograms by certain specific lesion[illegible] To begin with the external auditory canal, [illegible] change here—either an almost complete occl[illegible] sion by cerumen or osteoma, or an abnorm[illegible] width of the canal, both alterations affecting t[illegible] resonance frequency of the canal (normal [illegible] about 3,000 cycles)—does not, as would [illegible] expected, change the intensity of sounds reac[illegible] ing the tympanic membrane. Only when com[illegible] plete occlusion takes place does a form [illegible]

19. Kobrak, H. G.; Lindsay, J. R., and Perlman, H. B.: Experimental Observations on Auditory Masking, Laryngoscope **52**:870 (Nov.) 1942.

20. Smith, H. D.: Audiometric Effects of Voluntary Contraction of the Tensor Tympani Muscles, Arch. Otolaryng. **38**:369 (Oct.) 1943.

21. Perlman, H. B.: Lesions of the Conduction App[illegible] ratus, Arch. Otolaryng. **37**:680 (Sept.) 1943.

uction deafness occur, but in this connection found that there is more interference with propagation of high frequencies than with of low ones.

here are three factors which control the onse of any structure to sound waves: mass, on or stiffness, and resistance or damping. e factors will govern the kind of hearing irment which will result from lesions of the uction apparatus in man in which one or e of these factors are altered from their nor- state. The total mass of the drum and les (which have a weight of only 0.05 Gm.) ry small and is nullified still further by the ly efficient manner in which it is balanced nd the axis of rotation. An increase in the s produced experimentally by placing water lycerin against the drum produces inter- nce with high frequencies; similarly in cases exudative catarrh (with fluid against the rnal surface of the drum) a loss of hearing high frequencies is often seen, and pus or a e granuloma against the tympanic membrane give a similar hearing curve. On the other d, an increase in the tension or stiffness of conducting mechanism with no alteration in mass or the damping should, according to the s of physics, produce interference with the eption of low tones. This condition prevails en there is inequality of air pressure on the sides of the drum membrane and has been nonstrated to produce low tone impairment erimentally by Van Dishoeck, Fowler, Wever others; clinically it is seen in the type of iness noted following the air pressure changes ich occur in flying. Large losses in the drum mbrane or the ossicles, affecting as they do h the mass and the stiffness of the conducting chanism, result in hearing loss over the entire ustic spectrum; ossicular defects (including s of continuity) are more important than ge defects of the drum, and separation of incus from the stapes is worse than loss of malleus. Increased stiffness, which is typi- ly manifested in stapedial ankylosis, produces least at first a low tone deafness. Even in absence of a conducting mechanism, if the nd and oval windows are frozen by connec- e tissue, useful hearing for air-conducted nd is retained. The conducting mechanism also affected by any condition which alters its mping ability, i. e., its property of coming to st quickly after the system has been set in ration. An increase in the degree of resis- nce or the damping of the conduction appa- tus will cause an impairment in the response high tones. It must be taken into account, ally, that different frequencies vary greatly in their importance for the hearing of speech, the vibrations between 1000 and 3000 being of greatest value, and that intelligence, occupation and other circumstances influence a person's ability to hear, so that one cannot predict the degree of handicap in any given case by looking at a threshold curve alone.

HEARING AIDS ACCEPTED BY THE COUNCIL ON PHYSICAL MEDICINE OF THE AMERICAN MEDICAL ASSOCIATION

Coronation Acousticon Hearing Aid (carbon)
Acousticon Hearing Aid, Gold Medal Model (carbon)
Acousticon, Model A-45 (tube)
Acousticon, Model A-55 (tube)
Mfr.: Dictograph Sales Corporation
Aurex Hearing Aid (Semi-Portable) (tube)
Aurex Model C-B and Model C-A Hearing Aid (tube)
Mfr.: Aurex Corporation
Beltone Hearing Aid, Model 603H (tube)
Mfr.: Beltone Hearing Aid Company
Gem Hearing Aid, Model V-4, C-186 (tube)
Mfr.: Gem Ear Phone Company
Maicophone, Model 41 (tube)
Maico Hearing Aid, Model 42 (tube)
Maico Ace Hearing Aid (tube)
Mfr.: Maico Company, Inc.
Mears Aurophone, No. 98 (tube)
Mfr.: Mears Radio Hearing Device Corporation
Otarion, Model A-1(tube)
Otarion, Model A-2 (tube)
Mfr.: Otarion, Inc.
Paravox Radio-Tube Hearing Aid No. V50C
Mfr.: Paraphone Hearing Aid Company
Radioear, Model B-20 (carbon)
Radioear Masterpiece (carbon)
Radioear Special Electronic Type C Hearing Aid (tube)
Radioear Electronic 41 Junior Hearing Aid (tube)
Radioear Electronic Model 41 Hearing Aid (tube)
Radioear Model 45M—magnetic bone conduction receiver (tube)
Radioear Model 45M—magnetic air conduction receiver (tube)
Radioear Model 45CM (tube)
Mfr.: E. A. Myers & Sons
Ravox Hearing Aid (Semi-Portable) (tube)
Zenith Radionic Hearing Aid, Model HA (tube)
Zenith Radionic Hearing Aids, Models A-2-A, A-3-A and B-3-A
Mfr.: Zenith Radio Corporation
Sonotone Audicles no. 530, no. 531 and no. 533 (tube)
Mfr.: Sonotone Corporation
Telex Hearing Aid, Model 612 (tube)
Telex Hearing Aid, Model 900 (tube)
Telex Hearing Aid, Model 1020 (tube)
Telex Hearing Aid, Model 1550
Mfr.: Telex Products Company
Vacolite Model D Hearing Aid (tube)
Mfr.: Vacolite Company
Western Electric Audiphone, Ortho-technic Model (carbon)
Western Electric Ortho-tronic Audiphone (tube)
Western Electric Telephone Type Audiphone, Model J-1 (carbon)
Mfr.: Western Electric Company

AUDIOMETERS ACCEPTED

Maico Audiometer, Model D-5
Maico Audiometer, Model D-8
Mfr.: Maico Company, Inc.
Sonotone Audiometer, Model 20
Mfr.: Sonotone Corporation
Western Electric Audiometer, Model 6B
Western Electric 4C Audiometer
Mfr.: Western Electric Company

HEARING AIDS

According to Hughson and Thompson,[22] the comparison, so often made, between fitting eye glasses and fitting hearing aids is inappropriate, as the first is an ancient art in which great skill has been achieved while the second is still in its infancy. Furthermore, there is an essential difference between the two procedures since in the vast majority of instances the eye accommodates readily for sudden extremes of light and darkness, while the ear does not adjust itself well to sudden amplifications of sound such as occur when a hearing aid is worn over a long-deafened ear.

The proper fitting of a hearing aid is nevertheless the only form of therapy immediately available for the hard of hearing patient. Because the selection of this device is a complicated problem, involving two equally important factors —the human ear with the concomitant psychologic aspects and the electrical device itself—the authors considered it worth while to question some 136 patients who had been urged to purchase hearing aids on the advice of the Otological Research Laboratory of the Abington Memorial Hospital.

For testing their patients the authors used a method previously reported. This employs the lowest measured intensity of spoken voice which can be heard as intelligible speech. A series of spoken sentences were delivered to the unaided ears at loudness levels controlled in 1 decibel steps. These tests in addition to pure tone audiometric tests were made with calibrated equipment in a soundproof room. From a representative selection of different hearing aids, the patient is then tested in the same manner with at least three, of which the known characteristic response curve is deemed suitable for the loss shown by the audiogram.

Responses to a series of questions put by the authors were obtained from 97 persons who had been wearing hearing aids over periods varying from two months to twenty years. Seventy per cent of all the patients queried declared themselves satisfied with their instrument. Of the group fitted by actual measurement of hea gain, 80 per cent were satisfied. Ten diffe instruments and several different models of aid were used by this group of patients. O vacuum tube aids, no single make is outstan in its performance either with air or with b conduction so far as the replies to this quest naire indicate. The function of fitting hea aids belongs, in the authors' opinion, to otologist both because the psychologic mak of the patient is an important factor and bec fitting hearing aids is a form of therapy.

Currier [23] makes the point that while ther a difference of opinion among otologists as to relative value of soundproof and so-called q rooms, the latter term has not been defi Watson has stated, for instance, that the dif ence between a soundproof room and a q office is slight—at most about 5 decibels in low tones—and concludes from this that necessity of a soundproof room has been o emphasized. A number of papers dealing w hearing tests give a "quiet room" as the site the tests without any data as to the noise le although it is well known that 10 or eve decibels is of importance, particularly in no improvement in cases of impaired hearing. C rier noted that existing data on average n levels in varying places, including offices, v considerably—a fact which he does not find s prising after watching the needle of the n meter in his studies. These dealt with inve gations in fifteen test rooms in or near St. Lo He found that the approximate noise level in offices of the otolaryngologists was 35 deci and that in their testing rooms less than 24 d bels. Audiograms taken in the latter w approximately 20 per cent less accurate t those taken in the soundproofed room of the n versity, the tones below 2048 cycles per sec being the ones chiefly affected. He also co mented on the fact that the technic used audiometric examinations varies greatly in (ferent offices, making comparison of reco from different offices difficult.

Grossman [24] discusses the acoustic proper of the external canal of the ear and of the mid ear with special reference to the fitting of he ing aids and the design of individual ear mol The author begins with the observation that average ear mold appears to weaken the hi frequency partial tones of speech, while on other hand if the receiver of a hearing aid connected with a flat ear piece these tones perceived more clearly; patients suffering from

22. Hughson, W., and Thompson, E.: The Hearing Aid from the Patient's Point of View, Arch. Otolaryng. **38**:252 (Sept.) 1943.

23. Currier, W. D.: Office Noises and Their Eff on Audiometry, Arch. Otolaryng. **38**:49 (July) 19

24. Grossman, F. M.: Acoustic Sound Filtration Hearing Aids, Arch. Otolaryng. **38**:101 (Aug.) 19

ptive hearing loss hear better with a flat iece than with an individual ear mold. It ell known that the resonance imparted to h by the external auditory canal depends he length of the canal, its cross-sectional and the impedance of the drum. The tion of a channel in an acoustic conduit, r expanding or constricting in nature, ren- the conduit frequency selective, provided he cross section of the conduit is small com- d with the wavelength. Grossman conducted riments with different types of molds, all g the same length of 22 mm. but widths 5 mm., 3 mm. (the conventional type) and m., to find out how they influence the trans- ion of sound from the receiver of a hearing to the drum. His conclusions were as ws:

e individual ear mold of present design influences ransmission of sound from the receiver to the ear tenuating higher partial frequencies [with resultant tion].

e design of mold for middle ear impairment should ferent from that for perceptive hearing loss. The for the former disability should have a long tip, he diameter of the sound-conveying canal should t less than 3 mm. The mold for perceptive hearing on the other hand, should have a short tip, and the -conveying canal should be as large and straight ssible. [The author adds that a side branch orifice e latter is preferable.]

has been shown for ankylosis of the stapes that transmitted from an air conduction receiver acts transmitted to the ear by bone conduction.

iddle ear impairment of hearing is not always of structive type exclusively, but produces symptoms strongly suggest pathologic nonlinear distortion sound transducers in the ear.

ost of the material contained in the address by Fowler,[25] before the Section of Otology e Royal Society of Medicine in March 1943 miliar to American readers. He stresses the rtance of the audiogram in general and the lute necessity of this record for the pre- ing of hearing aids. He emphasizes the ssity for a uniform technic of recording ing levels for air and bone conduction by se of the symbols familiarized by him, as as the fact that a standard zero level of age normal hearing has now been established e Council of Physical Therapy of the Ameri- Medical Association and is used by all the rican audiometers. A worth while inclusion is connection consists of Swedish and Ger- audiograms and a comparison of these with rican audiograms—a matter which should f interest to those American readers who ot familiar with foreign audiograms.

Emphasis is laid on the necessity for frequent calibration of the audiometers, as well as on the importance of ascertaining the noise level in the testing room. Fowler asserts that only 15 to 20 decibels of noise is eliminated from the ear of the patient by the use of the latest receiver, so that noisy surroundings may lead to inaccurate results and conclusions. He again stresses the fact that the presence of noise results in raising the intensity of the examiner's voice during speech and whisper tests. Rather than use a constant masking noise, as has been suggested, he prefers the use of a sound level meter which records the intensity level of the examiner's voice. By watching this apparatus, a picture of which is included in the article, the examiner can learn to control his voice so as to keep it at an average level of intensity nearly all of the time.

Fowler believes that a pure tone audiogram may be used to estimate accurately the patient's capacity for interpreting speech if the examiner makes use of the tables (of the relative importance of each tone in the production of speech) established by Fowler Sr. These were based on years of study with patients and the work of Fletcher, Steinberg and Gardner, and others, and are quoted as follows:

250	500	1000	2000	3000	4000	8000
3%	15%	25%	30%	15%	10%	2%

A number of audiograms are included to show that this method of weighting frequencies furnishes an adequate explanation for the difference in the capacity to hear speech exhibited by persons with hearing losses which at first glance look quite similar. Fowler also explains the role of recruitment of loudness in patients with partial nerve deafness in accounting for seeming discrepancies in the ability to hear speech.

Certain facts must be borne in mind when hearing aids are prescribed. Ordinary speech in a quiet room reaches the ear at a level varying from 30 to 60 decibels, or an average of 45 decibels; below the 30 decibel level interpretation of speech becomes inadequate. For conduction deafness the hearing aids work well, because, although considerable amplification may be required, interfering factors do not play as great a role as in the case of nerve deafness, in which delicate adjustments for distance and voice must be made because of the recruitment element. Fowler believes that air conduction hearing aids of the latest type are more efficient than bone conduction aids; he also believes that no patient with a deafness which is indicated by a threshold on the average less than 30 decibels above the normal threshold for the speech range and hardly any patient with a defect of over 85 decibels will

Fowler, E. P., Jr.: Audiogram Interpretation the Fitting of Hearing Aids, Proc. Roy. Soc. Med. 1 (June) 1943.

be helped by a hearing aid, and that lip reading is generally best recommended ahead of a hearing aid, as few patients will bother to learn lip reading after they have acquired hearing aids. A number of useful practical hints on the subject are also given.

In the discussion it was noticeable that British otologists were rather skeptical about accepting Major Fowler's dictum about the accuracy of the pure tone audiogram as a guide to the patient's ability to hear speech; nearly all of those who commented felt that speech tests, although imperfect, were essential. A good part of the discussion centered about modification of speech tests for military purposes, especially for the examining of air force personnel, so as not to eliminate men who may have some impairment but are still fit for duty. Recommended were tests which took account of special conditions. For instance, aviation candidates were tested with ear phones of the air service pattern, into which carefully selected monosyllables were fed while at the same time noise of a character customary in military aviation was present as well. It was claimed that by the use of these tests a number of suitable men were saved for the service.

After World War I about 40,000 persons with impaired hearing returned to civilian life. On this numerical basis, according to Hughson and Thompson,[26] one may expect a quarter million after World War II. The Army and Navy Surgeon Generals' offices have taken steps to deal with this problem, also the Veterans' Bureau and the League for the Hard of Hearing and other established rehabilitation organizations. The entire situation is a medical one, and the American Academy of Ophthalmology and Otolaryngology has appointed a committee to insure all possible aid to these aural war casualties. Medical and surgical treatment will apply to relatively few of these, and the one ready solution for most will be a properly fitted hearing aid. Otologists have neglected the professional obligation of intelligently advising their patients in the selection of an appropriate and efficient hearing aid. This is time consuming, requires infinite patience and a high feeling of responsibility for psychologic reactions, to say nothing of expense for equipment and the meager return for the time and effort required; yet, in spite of the organizations mentioned, many patients will come to the private otologist, who should prepare himself to advise intelligently as to the pros and cons of hearing aids.

26. Hughson, W., and Thompson, E.: Hearing Aids, Arch. Otolaryng. **39**:245 (March) 1944.

There are three types of hearing loss: ty a uniform loss throughout the audiom range; type 2, a greater loss for low frequen type 3, a greater loss for higher frequen These factors are all modified by the degr impairment, its duration and type, and the and the social condition of the patient; so deaf person will always be an individual cannot be treated simply as a member of a gr

The authors concern themselves with vacuum tube type of aid. About 25 of these been accepted by the Council of Physical T apy. They amplify principally frequencies in speech range, namely 256 to 4096 cycles, have a certain degree of selective emph usually in the higher range. Low tones, if m fied, are usually suppressed.

The fitting of a hearing aid must be a f tion of the otologist. It is no easy task, bu essential one. The deaf subject wants intel bility of speech; therefore, the hearing aid m supply compensation for a given deficiency. other factors are essentially irrelevant. preferred method of determining the speech ception level is in a soundproof or at lea sound-treated room by spoken voice with accurate attenuating system presented b high fidelity loud speaker; it should be cap of control in steps of 5 decibels over a ra of 50 decibels above normal. Phonogr records may be used under the same surro ings as described for the preferred method. a third method a standard 2 foot (60 cm.) m phone is used with felt disks graded to fi various levels to act as attenuaters, each introducing 10 to 15 decibels of attenuation; spoken voice is used, first without and then the hearing aid, whose efficiency may be jud by the amount of attenuation it can overc No hearing aid, either of air or of bone duction type, that fails to give 30 decibels improvement should be considered. It should remembered that bone conduction aids hav hearing efficiency of 30 decibels below nor air conduction, which means that much m energy is needed to activate them. Fitting of ear mold should be preceded by an otosc examination to determine the patency of canal and the intactness of the membr tympani.

Otologists must assume their responsibility the broadest manner. They must be fami with the construction and the performance hearing aids; their technic of fitting must c form to a more or less standard proced The medical prerogative in this field should jealously guarded. Hearing aid compan manufacture and sell primarily for pr

nd the fact that their products shall be good the hearing aid companies should have no ation or concern. For greater detail in ription of hearing aids and of fitting technics rticle should be read in the original.

he consideration of the hearing aid as a apeutic measure, according to Hughson and er,[27] marks an advance in the approach he problem of the alleviation of hearing loss. ut 80 per cent of persons with deafness are amenable to help by medical or surgical pro- ures. The recommendation that such patients aught the use of hearing aids is the obvious er. A hearing loss of 40 decibels of a year's ation or more in a patient of middle age or ond seldom offers much hope of benefit ugh treatment. In carefully selected cases ern surgery offers hope, but in none can be actual promise of benefit. The psychol- of deafness is of great importance in the roach to this significant problem, and when ther properly indicated means at one's dis- l have been employed one has no alternative the recommendation of a properly fitted ing aid. This procedure carries with it a rantee of expected gain.

he otologist must assume responsibility for g hearing aids. Speech reception is the deratum. The successful fitting of a hear- aid depends largely on one's knowledge of reaction of the patient to an electrical device. h all available refinements of technic, satis- ion may be obtained in about 80 per cent of cases, based on the achievement of useful ing and not only on the audiometric gain of ecified number of decibels.

deally soundproofed rooms and an adequately trolled electrical sound source should be ilable. Less technical procedures may be ssary for practical otologic purposes. A aphone with attenuating attachments has n devised for a reasonably accurate measure- nt of the gain in speech developed by any ing aid. The entire procedure is time con- ing and requires patience, perhaps for five rs, but is worth the effort.

he otologist's interest and support make the ing period a comparatively simple one, and edical or surgical measures should happily ceed thereafter, the aid may be laid aside.

n another article on hearing aids Hughson [28] mates that there will be a quarter million al casualties in this war, including those caused by serums, antitoxins and prophylactic drugs. In rehabilitation, medical treatment is relatively ineffective and surgical treatment applicable in only a relatively insignificant few cases. For the vast majority there is one solution, the proper fitting of a hearing aid. These are the otologist's chief concern. The Army and the Navy and the Veterans' Bureau are primarily concerned with the profoundly deaf requiring lip reading and speech training for their rehabilitation. There are three general types of deafness: a fairly unform loss throughout the audiometric range; loss accentuated at the higher frequencies (nerve deafness) and loss at the lower frequencies as in chronic suppuration. These factors are all modified by the duration and the degree of impairment and by the age, the sex and the social condition of the patient. A deaf person is always an individual and cannot be treated as a member of a group, and this psychologic factor is important. About 25 vacuum tube hearing aids have been accepted by the Council of Physical Therapy of the American Medical Association. The amplification is mostly in the speech range, but a certain degree of selective emphasis can be developed. The fitting of a hearing aid must be the function of the otologist, who must acquaint himself with the intricacies of this adjunct to his armamentarium. The deaf person is interested only in increasing his ability to understand speech. The instrument must restore the vital quality of intelligibility. Uncontrolled voice and whisper tests are inadequate. A soundproof room is ideal; a sound-treated room will help. The best method is the use of the spoken voice controlled and measured, electrically presented through a loud speaker of high fidelity; the second method is the use of the electrically controlled voice presented by a phonograph record; the third is the use of the spoken voice as presented through a roughly calibrated nonelectrical device whose intensity levels can be reasonably well estimated. For this last purpose the author has devised a megaphone with removable felt disks for damping, which will give a reasonable control over intensity, as will the relative distance at which this instrument is used. By these methods a measure of the actual improvement in speech intelligibility brought about by the hearing aid may be had. In general, vacuum tube instruments are superior to carbon, and the air conduction appliance, which must have a well fitted ear piece, is better than the bone conduction receiver, the efficiency of which is 30 decibels below normal air conduction and therefore is useful only in cases with marked superiority by bone conduction.

. Hughson, W., and Reger, S. N.: The Use of ring Aids, Tr. Am. Acad. Ophth. (1943) **48**:287 rch-April) 1944.

. Hughson, W.: Hearing Aids, Tr. Am. Acad. th. **48**:180 (Jan.-Feb.) 1944.

Hearing aids are sold primarily for profit. Hearing aid manufacturers should have no obligation beyond that of insuring that their products shall be good ones.

John J. Shea, in discussing Dr. Hughson's paper, stated that his opinion as an examiner on the American Board of Otolaryngology is that the otologist is not as well equipped in his private practice as he should be for making these examinations and compares him to an ophthalmologist telling the patient to take his prescription and buy a pair of glasses.

In further discussion of Dr. Hughson's paper, Dr. C. F. Harkness expressed the belief that the total number of aural casualties likely to result from this war has been overestimated. He called attention to the fact that hearing aids are the product of the brains of engineers, not otologists. The percentage scale for syllable articulation developed by Fletcher and Steinberg,[29b] by which one can evaluate the effectiveness of various types of amplification, is a practical approach to the perception of the human voice. The tests are done in a soundproof room, but neither the otologist nor the deafened patient carries on this test for perception in an environment in which the noise level is at zero. Moreover, the surrounding noise level is different for the normal and for the deafened person. Are these factors of moment in the selection of the hearing aid? Uniform amplification does not bring all speech frequencies to the same level as compared with normal sensitivity, although it amplifies each tone by the same amount. The carbon hearing aid is of great benefit to the group with conductive deafness. Selective amplification disturbs the usual relative speech sound levels. The hearing loss at threshold does not remain constant with increase of intensity. This is more marked in perception deafness. These are a few of the factors that add to the complexity of prescribing hearing aids. However, Dr. Harkness agreed with the author in some of his conclusions:

> . . . You can drive an automobile and not know what is under the hood. [He held that if the] prescribing of hearing aids be exclusively ours . . . we must qualify for the job. . . . We must learn the causes of adventitious noises, of static and the like . . . the reasons for stability or lack of stability from microphone to earphone . . . the limits of tone and pitch selectivity in the carbon aid by changes in combinations of diaphragms. In the vacuum tube aid we must learn the results of alterations in the vacuum tube amplifying circuit . . . why the carbon and why the crystal microphones should be prescribed . . . that Rochelle salt crystals exhibit electrical charges when subjected to pressure and how that affects their action in a microphone. [In short, the otologist should be an acoustic physicist.] In this question of who fits the hearing aid must be considered economic factors and the most good to the greatest number.
>
> I agree . . . that the otologist should be familiar with approved hearing aids . . . and the psychologic factor is a most important one. Let us not assume the right to a medical prerog unless we can justify it by the services that the and file will deliver. This will be measured by patient's sense of value received. . . . Will ticing otologists as a group perfect themselves wi knowledge . . . and give the necessary metic time-consuming 'examinations?

Finally he asked whether the patients w be willing to pay for this and held that answer is "No." During the carbon aid pe he tried it, had the necessary instruments stalled and found that the demand did not ju the employment of a skilled technician an could not give the necessary time. With s tive amplification the task would be m difficult.

He said that the author's megaphone tes is ingenious but gives, as the author state rough estimate; it is no doubt practical but l something in standardization for general use

He urged that otologists cooperate, that become familiar enough with hearing aid advise wisely, that they avoid any taint of c mercialism and that they strive to help the people in the most practical way.

Hughson and Westlake [29a] state that the p lem of rehabilitation of aural casualties after war is certain to be of considerable extent s there are six times as many men in the ar forces as there were in World War I. quate rehabilitation of the deafened must viewed in terms of the total adjustments of c plete persons rather than in terms of the fection of single items of reconstruction. achieve the best result, many types of ser will have to cooperate besides those concer with medical treatment and hearing aids: p chologic study, lip-reading instruction, per ality adjustment, speech training, vocati adjustment and an efficient follow-up service all needed for rehabilitation.

The Committee on the Conservation of He ing of the American Academy of Ophthalmol and Otolaryngology has appointed groups otologists to assist and further organize aural rehabilitation programs in their respect states. The authors submit a detailed plan the organization of the work through state local subcommittees, which will include merely otologic but other types of service

29. (*a*) Hughson, W., and Westlake, H. D.: Ma for Program Outline for Rehabilitation of Aural Cas ties Both Military and Civilian, Tr. Am. Acad. Op January 1944, supp., p. 1. (*b*) Fletcher, H., and St berg, J. C.: Articulation Testing Methods, re B-436, Bell Telephone Laboratories, Inc., Novem 1929.

ed for rehabilitation. It is proposed to lish clearing house clinics adequately staffed equipped for identifying, diagnosing and ing hearing impairments in returned ser- men.

interest to otologists are two appendixes ed to the use of the audiometer and to ng aids, respectively. These two appendixes w accepted ideas but include a number of ls recommended by the authors. For audi- ry, pure tone or discrete frequency audi- ers accepted by the Council on Physical apy are to be used, but all must be cali- d, preferably in some university physics atory. Soundproof rooms are preferred. substitute, a room not less than 6 by 8 feet y 2.5 meters) with a tight-fitting door, rably weatherstripped, and a noise level of ecibels may be employed; the authors state roughly such a level is achieved when no aneous noise is audible to the normal ear. recommend that in operating the audiome- the examiner start with the frequency of cycles, proceed in sequence to the highest ency available on the instrument and then n to 512, and then to 256 and 128. A rea- bly loud signal should be presented first and nuation introduced in 5 or 10 decibel steps no response is indicated. Further detailed uctions for testing are given. The technic esting bone conduction is described, but the ors state that no brief is held for the racy of the tests. Masking is to be done never the difference in hearing between the ears amounts to 30 decibels or more. The nsity level of the masking noise should range 60 to 80 decibels for tests of air conduction from 40 to 75 decibels for tests of bone con- ion, or even as high as 90 decibels for the r; all tests for bone conduction require king of the other ear.

is stated that any person with a hearing loss oth ears of 35 decibels or more in the speech uency range and whose defect is not ame- e to treatment is an appropriate subject for fitting of a hearing aid. It is considered the fitting of hearing aids is the function of otologist, and members of the medical pro- ion who follow this specialty are urged to aint themselves with the intricacies of these ruments. The writers point out that although e tone audiograms fall into the accepted e groups of hearing loss, namely, uniform, tone and low tone, there are countless ations and dips which make it impossible to me that any given hearing loss can be com- sated for by an aid with a complementary racteristic. The only way to achieve a practical result is through speech reception tests, which are described in some detail.

To be of value speech tests must be presented to the listener in the same degree of controlled intensity as are individual frequencies by the properly calibrated audiometer. Three methods are available:

(*a*) The spoken voice is used, controlled electrically with an accurate attenuating system and presented indirectly to the listener by means of a high fidelity loud speaker. "The intensity of the voice must have a calibrated attenuating control capable of modifying loudness in steps of 5 decibels or less over a range of 50 decibels above normal threshold." A list of sentences is read, and the intensity of the speaker's voice is modulated by observing the excursion of a decibel meter indicator needle. The sentences are to be repeated by the patient. Accurate understanding of speech involves at least 60 per cent correct responses.

(*b*) Phonograph records are used with an electrical pick-up permitting any known intensity. The sentence lists used are those devised by the Bell Telephone Laboratories, Inc., and are to be found in "Articulation Testing Methods" by Fletcher and Steinberg.[29b]

(*c*) If none of the above equipment is available, a reasonably accurate test can be made by using a 2 foot megaphone. The author states that normal speech is 40 decibels above the normal threshold of hearing and that such a megaphone increases the intensity of normal voice at the listener's ear by approximately 20 decibels, making a total of 60 decibels of available intensity. With this degree of loudness "few impaired hearing levels susceptible to artificial aid would fail to be reached." Attenuation can be produced by an ingenious system of placing felt pads within the megaphone.

The authors state that usually no hearing aid should be considered unless it gives a gain of 30 decibels in speech reception.

The general characteristics of hearing aids as well as detailed instructions for making ear molds are given. The latter is considered to be a proper function of the otologist.

An additional appendix lists nonmedical services, such as psychologic study, instruction in lip reading, speech training, personality and vocational adjustments and follow-up service. In the discussion of lip reading and speech training concrete suggestions and names of sources of teachers are given.

Utley and Goebel [30] stress the importance of the hearing aid in the education of the deaf

30. Utley, J., and Goebel, M.: A Comparative Analysis of the Results of Testing Individual Hearing-Aids in a School for the Deaf, Speech Monogr. **10**:40, 1943.

and the hard of hearing child. The group hearing aid is one answer to the problem, but it is insufficient after the child has matured enough to assume the responsibility of an individual aid, as the group aid can be used only in the room where it is installed.

Almost all deaf and hard of hearing children can be benefited to various extents by hearing aids. It was the purpose of the authors to determine the efficacy of different makes of hearing aids specifically fitted to children with various degrees of hearing loss, the comparison to be made in as concrete a way as possible. The fitting and the state of repair of the aids were left to the consultants of the various companies making the aids; the authors admit that not all of the best aids were represented.

The experiment was carried out at the South Carolina School for the Deaf. Three different makes of hearing aids, all of the vacuum type, were used, and every effort was made to see that each instrument was at maximum operating efficiency. The instruments had served the respective children during a trial period prior to the tests. Twenty-one children, ranging in age from 11 to 20, were selected for the study. Preliminary audiograms were obtained in each instance, and the aid was fitted to the better ear. The hearing loss for the pure tones was calculated on the basis of Dr. West's method. Then the patient was placed about 10 inches (25 cm.) away from a loud speaker, the latter being directly in front of him, and audiometric determinations of his hearing both with and without a hearing aid were made. The number of decibels of improvement through the use of the hearing aid was added to figures obtained from the pure tone audiogram made with ear phones and the percentage loss again calculated by the method of West. This could be checked with the percentage loss obtained from the original pure tone audiogram and the percentage gain for speech as a result of using the hearing aid estimated. A number of children were tested with more than one aid.

The results indicated significant differences in the amount and the kind of improvement rendered by the three aids tested. For instance, one type of aid was found to be of no practicable benefit. A second one benefited the children most at 1024 and 2048 cycles, the average benefit in terms of percentage gain for the speech area being 7 per cent. A third aid, the best of the three, gave the greatest improvement at 1024 with additional significant gains at 512 and 2048. The average gain in the speech area was 14 per cent. The authors noted during the study the great psychologic and physical change demonstrated by the children as a result of discover that they had "usable" hearing.

Fenner [31] considers that small caliber weap affect chiefly the internal ear. According to h tests with tuning forks, a monochord and spe are insufficient to give a complete picture of damage sustained, only audiometry being a quate for this purpose. The audiogram of aco tic trauma involving the cochlea shows a s decrease between 1000 and 4000 decibels. T is considered a characteristic sign of acou trauma of the inner ear. Tinnitus when pres can be measured by the audiometer as to pi and intensity.

The prognosis in these cases is uncert Some improvement may be expected after s months; at the end of a year the hearing is usually fixed.

It is suggested that a good deal may be d in the way of prevention by making previ audiometric tests for unusual sensitivity to sou When this condition is found, the subject sho be relegated to a branch of service where posure to noise is less marked.

The audibility of the radio voice, Jobs says, must be considered from two points of vi —that of the broadcasters and that of audience.

The first involves clear enunciation, wh goes a long way to help the deaf part of audience and adds to the comfort of those wh hearing is good. This faculty varies consider among announcers.

The second factor involves consideration all types and conditions of listeners: the hig educated people, the quick thinkers, the poo educated people, the slow thinkers, those w normal hearing, those with defective hear the young with quick reactions and the eld with slight senile deafness and a time-lag interpreting the sounds heard. The last c sideration is considered by the author to important, particularly in middle aged and people with impaired hearing. A rapid spea induces fatigue following the strain of listeni while a speaker who speaks at an optimum r with adequate pauses can be readily followed.

The statistics of the Rockefeller Foundat as to the presence of some three million child with impairment of hearing in this country matched by the estimate that 1 in every 6 p sons in Britain is defective in one or both e Bunch's statistics as to the loss of hearing high tones are also quoted, but the author stres the fact that in older people there is also slow

31. Fenner, E.: Audiogram of Acoustic Trau Schweiz. med. Wchnschr. **73**:823 (June 26) 1943.

32. Jobson, T. B.: Audibility of the Radio Vo Proc. Roy. Soc. Med. **37**:263 (April) 1944.

oration, making for delayed interpretation hat is heard. This time-lag, which is not onstrated by the audiometric, fork or voice as ordinarily performed, is considered of t importance in accounting for difficulty in ng certain broadcasts. People who are some- unfamiliar with English also have a time- The highest note in the female voice is way between c-512 and c-1024, and the low- ass note in the average male voice is midway een c-64 and c-128. Most deaf people hear n's voice more easily than a woman's. For mple, the author's deaf patients say they can every word of Mr. Churchill's speeches hardly a word of some of the popular edians. The author recommends a male with an optimum rate of speech combined adequate pauses as best suited to be heard he greatest number of people, including those poor hearing.

r. John Snagge, representing a British dcasting Corporation, admitted that there is much to be overcome in the selection and training of announcers for the radio. There not only people with good and impaired ing but also people with many dialects are trying to listen under all sorts of ditions. Enunciation with proper mobility he mouth, the absence of affectation or idio- crasies, which are magnified over the micro- ne, all are important in the radio speaker. re is a general optimum of speed, but also an vdiual optimum, as often speakers using the e rate (176 words per minute for news) as to the ease with which they make them- es heard by the audience. The secret of d does not lie in words per minute but in per and adequate pauses and in realizing and smitting the sense values of the English uage. The British Broadcasting Corpora- has not only adopted a standard form of lish, with as far as possible a standard pro- ciation, but has developed and established a dard form of reading the news bulletins. It been found that dialectic variations from the dard were made the subject of complaint. h reference to the time-lag a curious fact e to light recently. In following up com- nts that the midnight news was read much fast, they discovered that there was no altera- whatever in the speed of reading at different s of the day, leading to the conclusion that only cause for the increased difficulty in ring was the slower reaction time of the ner following long hours of work.

Negus brought out the well known point that ear reconstructs the sound emitted by hear- the overtones. He also called attention to masking effect of low tones on high ones. If one could have a selective filter which would cut out tones below 600 and above 3000, both masking effect and tones difficult for older persons to hear would be eliminated without impairing the audibility of the broadcast.

Fowler agreed with the foregoing observations and called attention to the importance of clear pronunciation of the consonants, especially of s, t, and th, in contributing to the intelligibility of speech.

Silverman [33] comments on the fact that understanding of speech even in seasoned users of hearing aids is often limited, although perception of sound as such seems to be adequate.

Starting with the observations of many writers from Ernaud in 1761, through such well known otologists as Urbantschitsch and Goldstein, on the possibility of improving the hearing in deaf people by acoustic education, the author determined to make a series of experiments on the effect of acoustic education in improving the intelligibility of speech for users of hearing aids.

Seven people who had used a hearing aid for at least one year and who had acquired understanding for speech naturally prior to the onset of their deafness volunteered for a period of acoustic training. Their ages ranged from 24 to 65 years, and the periods over which a hearing aid had been used were from two to thirty years. Preliminary tests for perception of words and sentences, as well as training courses, were made from a specially selected word list, as well as from 25 sentences of the Fletcher-Steinberg articulation list. The test material was presented on electrical transcriptions under standard and uniform conditions in a room in which the average noise level was 35 decibels. The subjects reported for training lessons two evenings per week for a period of ten weeks. Each lesson lasted one hour. The following principles were considered in constructing and presenting the training material (the bracketed portions represent condensations made by the reviewers):

1. Speech was presented from electrical transcriptions, employing the equipment previously described, which eliminated the possibility of lip reading.

2. A lesson consisted of: (*a*) A series of words incorporating a given element of speech in various relationships. During the latter half of the training period these elements were contrasted with other elements of speech (in words) with which they were likely to be confused. (*b*) A series of unrelated sentences . . . and connected passages requiring further synthesis and cerebral organization of auditory language stimuli.

3. The subjects were furnished complete scripts of the material in order to form associations between the known (the script) and the partially distorted (the speech emanating from the speaker). [The subjects

33. Silverman, S. R.: Training for Optimum Use of Hearing Aids, Laryngoscope **54**:29 (Jan.) 1944.

could thus evaluate their hearing ability after repeated exercises by referring to the script.]

4. A variety of untrained male and female voices was used in recording the material [for the exercise in order to help the patient] accommodate for all types of speech.

[5. Windows in the room used for the acoustic training were kept purposely open to simulate ordinary hearing conditions.]

6. Individual differences in auditory thresholds as represented [on pure tone audiograms] were taken into consideration in placing the subjects in the room during the lesson.

[7. Group teaching rather than individual training was done.]

The results indicated that 6 of the 10 subjects showed some improvement in the understanding of speech as a result of the acoustic training. The one case in which no improvement was indicated involved a subject who began with no appreciation of speech through a hearing aid. The gains for the understanding of words ranged from 0 to 36 per cent, with significant improvement in most instances; gains for understanding of sentences ranged from 8 to 52 per cent. The author feels that the evidence suggests that a period of systematic acoustic training for users of hearing aids is desirable after the acquisition of their instruments.

Hereditary characteristics are determined genes; these are located in the chromosom A fertilized human ovum contains 24 pair chromosomes; one of each pair was in the u tilized ovum; the other was brought in by sperm. Hereditary deaf-mutism is a rece characteristic; that is, there must be genes ca ing abnormal auditory development in both ovum and the sperm. Either the male or female parent may transmit such an abnor gene from some ancestor without having deaf himself. But in order that the offsp be deaf, it is necessary that genes carr abnormal auditory development be inher from both sides. Consanguinity itself is n cause of deafness. It is only that the par when related by blood may both have inher genes carrying abnormal auditory develop from a common ancestor, and the deaf offsp has received these genes from both sides. W both parents carry one gene each for deaf the other being normal, 1 of 4 children, accor to the mendelian law, will be deaf.

34. Odiorne, J. M.: Genetic Principles and the heritance of Deaf-Mutism, Ann. Otol., Rhin. & La **53**:153 (March) 1944.

Book Reviews

Eye, Ear, Nose and Throat Manual for Nurses. By Roy H. Parkinson, M.D., head oculist and aurist to St. Joseph's Hospital, San Francisco. Fifth edition. Price $2.25. Pp. 247, with 82 illustrations, including 2 in color. St. Louis: The C. V. Mosby Company, 1944.

The author presents his comprehensive manual, now in its fifth edition. The volume totals 247 pages, and the entire format is first class. There are in all 82 figures or illustrations, which clarify the lucid text material.

All phases of thorough nursing care for the eyes, ears, nose and throat are dealt with, and especial attention is given to operative technic, the layout of instruments and the postoperative care. The ocular, aural and nasopharyngeal problems as met with by the public health nurse are adequately covered in 34 pages. The index is good.

This manual is recommended to all otolaryngolo (and oculists) for use in their hospitals and may serve many chiefs in their sincere efforts to obtain most efficient operative and postoperative results.

The Common Cold and How to Fight It. Noah D. Fabricant, M.D. Price $1.50. Chic and New York: Ziff-Davis Publishing Comp 1945.

This small volume covers a large field. The of the author has been to present to the laity a handb of information and discussion on the numerous ph of the common cold. The reasoning throughout is s and the message is convincing. Dr. Fabricant is where he wishes to be firm and facetious where wishes to be facetious.

Correspondence

ST EXPERIMENTAL USE OF CARTILAGE TO MAINTAIN A PATENT FENESTRA IN BONE

the Editor:—I am sending you a direct transcript from the transactions of a clinical meeting held at Manhattan Eye, Ear, Nose and Throat Hospital, 1, 1944, as it seems to establish not only priority he use of cartilage but also the comparative values e different types of cartilage obturators. I hope will publish the article as it is. I am also sending under separate cover, two pictures which were of the original experiment.

PHILIP G. MACDONALD, M.D., New York.

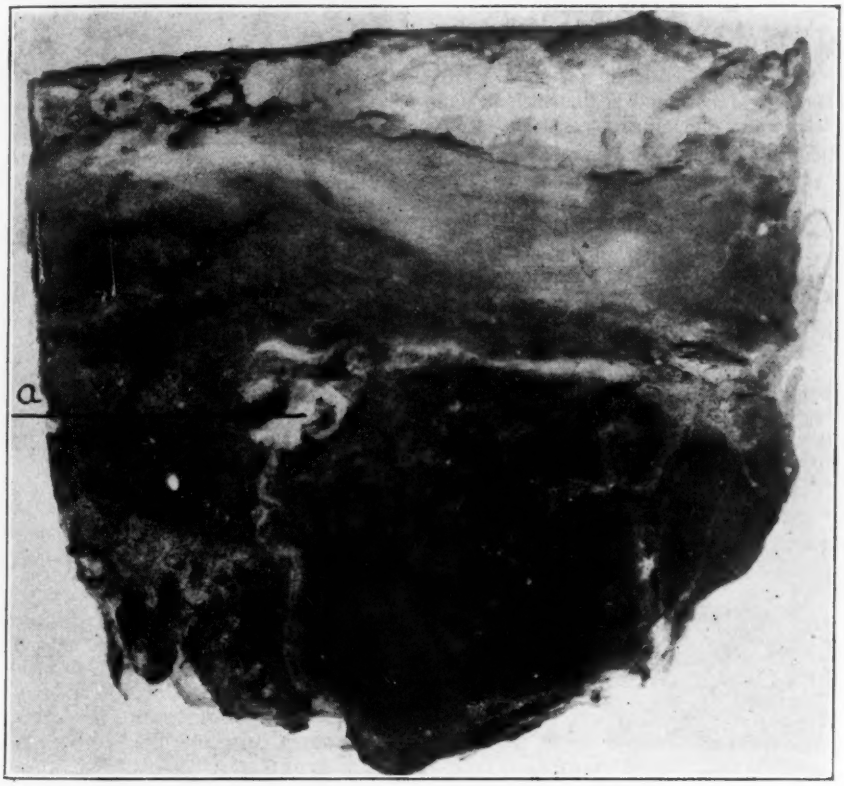


Fig. 1.—Patent fenestra in a hyaline cartilage button (*a*); × 3. The control opening is completely closed and demonstrable. The cat was killed four and a half months after operation.

[Transcription]

liminary Report of Animal Experiments to Secure Permanent Osseous Fenestra.

R. MACDONALD: Dr. Kelly and Fellow Doctors: large percentage of failures with the operation for sclerotic deafness is due to the closure of the fenstra. Many attempts have been made to keep the stra open. You are well acquainted with these mpts. Different kinds of burrs have been used, that burrs made of different metals, lead, steel and gold. ferent kinds of obturators have been used, but these e been abandoned. Then different types of tissue have been tried—for instance, skin and mucous membrane. Skin and mucous membrane are proliferative tissues and by proliferating filled the fenestra. Roentgen ray and radium have been used, but again the result has been a failure. Platinum and gold obturators have been used but produce severe foreign body reactions, and the proliferation from these closed the fenestra.

Last winter I discussed this problem with Dr. Fomon, and he mentioned cartilage as a possible solution to the problem of maintaining a permanent fenestra. This was extremely interesting because cartilage, as you all know, is lymph nourished and needs no blood supply. It unites with every tissue in the body, but there is no tissue which will grow into it. Cartilage maintains its size and shape indefinitely. Dr. Gillies claims that one can put pinholes through cartilage and after many years these pinholes are demonstrable. Cartilage to me seems to be the ideal material to use as an obturator.

With this in mind, I made two openings, side by side, in the temporal bone of a cat. Into one of these openings I put a hyaline cartilage button from which the center had been punched. The other I left open. In four and one-half months I killed the cat, and where the cartilage button had been put the fenestra remained very much the same as when inserted. The control opening, however, had completely closed.

About one month ago, I went to Dr. Marvin Jones and told him of my experiment on the cat, and he was

very much interested. I am now running experiments on a group of animals in this hospital and using different types of cartilage obturators—hyaline, white fibrous and yellow fibrous. In the first animal I used hyaline cartilage from the rib.

I am still using the temporal bone for these experiments as it is so much more accessible than the dense bone around the semicircular canals. It is well known that it is easier to keep a fenestra open in the dense bone around the semicircular canals than it is to keep an opening patent in the squamous portion of the temporal bone. I feel that if the cartilage will maintain a fenestra in the squamous portion of the temporal bone, it certainly should maintain an opening in the dense bone around the labyrinth.

As I was saying, in the first rabbit I used a button of hyaline cartilage from which the center had been gouged out to make a ring of hyaline cartilage. Alongside of this I made a control opening. In the second and third animal I used yellow fibrous tissue cartilage from the rabbits' ears. This cartilage is very thin and can be cut into strips. I cut strips of proper size and thickness to make rings in the fenestras of these rabbits. Of course, control openings were made alongside as in the case of the first rabbit. I have not used white fibroclastic cartilage as this is found in the sternum and intraverteberal disks, areas difficult of access.

I plan to let these animals live for six months, which is approximately equal to fifteen years in man. If cartilage will maintain a patent opening for six months in a rabbit, I feel that it will maintain a fenestra indefinitely in man, and one of the big objections to the fenestration operation will be overcome. If engravers can put the Lord's Prayer on the head of a pin, one surely can improvise a method to line a fenestra with cartilage.

Next fall these animals will have been killed, and I shall have the microscopic reports for you.

This paper was given prematurely, solely to get it on record. This work is also being done in Philadelphia, and I want to have it on record that the first a experiment was mine. I have only one specimen t port on, but this specimen was entirely satisfactory.

I shall have many specimens by October 1 and I to be able to tell you whether or not the procedure value.[1]

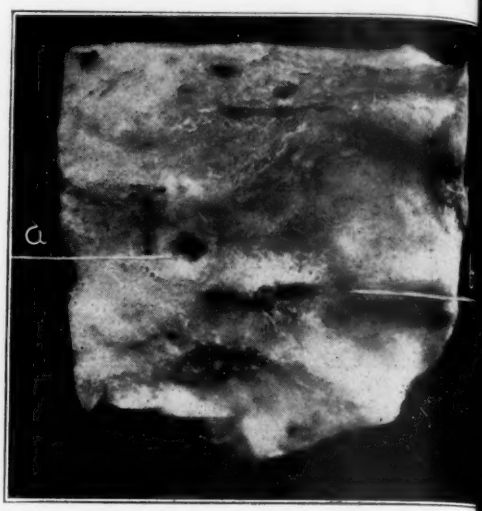


Fig. 2.—Patent fenestra in a collar of hya cartilage (*a*); about × 3. The control opening (completely closed. The animal was killed four a half months after operation.

115 East Sixty-First Street.

1. Since the specimens promised for Oct. 1, were spoiled in processing, experiments are now f run on a second series of animals, and a report wi made as soon as the fenestras in these animals h been completely investigated.

Abstracts from Current Literature

Ear

ÈRE'S SYNDROME—ITS MECHANISM AND MANAGE-ENT. MILES ATKINSON, Eye, Ear, Nose & Throat onthly **33**:392 (Oct.) 1944.

kinson read this paper before the Medical Society State of New York, May 5, 1943. The prepara- work was done in the clinics at the New York ersity College of Medicine and in Bellevue Hospital.

er reviewing the "mechanism" of Ménière's e, which he deems to be of a circulatory nature, escribes "management" in these cases, chiefly in ct to the use of histamine. The strength of the ion is determined by the histamine base, and in regard the various salts differ widely. Atkinson histamine dihydrochloride containing 0.57 mg. of to each 1 mg. of salt. Dilution of 1 cc. of a 1 to solution of the salt with 9 cc. of distilled water ces a solution of approximately 1 to 20,000 of mine base. The detailed directions for the injec- re then given.

ncluding, Atkinson makes the following points: y intradermal tests one can divide patients with ière's disease into two groups according to their tivity to histamine. 2. Of these two groups, one a primary vasodilator action; the other, a primary onstrictor action. 3. If treatment is carefully wed according to the tests just mentioned, the ts are "reasonably successful." 4. Relief of vertigo be envisaged, but only by individual attention to individual patient." At the end of 1942, the author 49 patients under review. Of these, 20 had been ely relieved for six months to two years; 25 were oved, and 4 were set down as "failures."

VOORHEES, New York.

RELATION BETWEEN SPEECH-SOUND DISCRIMINA-TION AND PERCENTAGE OF HEARING LOSS. JEAN UTLEY, J. Speech Disorders **9**:103 (June) 1944.

he author studied 51 pupils in a school for the deaf. ages ranged from 9 years 2 months to 24 years onths. Twenty-five subjects were male and 26 fe-; 21 were congenitally deaf. They were studied eans of individual audiometric tests made with the o D-5 audiometer. They were also given a test discrimination of speech sounds by paired words owels and for consonants. These tests were pre- ed over a multiple hearing aid, since none of the nts could understand speech without amplification. intelligence quotient was also available. Errors he vowel test and errors on the consonant test are tively correlated. Age was not a factor in the test. intelligence quotient of the patient was not a factor. higher the frequency at which loss occurs, the ter the increase in errors of discrimination between ds. Vowel losses are particularly associated with es at frequencies 1024 and 2048. Losses at 512, and 2048 are about equally correlated with errors discrimination of consonants. Residual hearing at and 2048 is equally important on the basis of rimination of vowels and consonants. Five different hods of determining the percentage loss for speech employed, the Sabine showing the largest range of percentage score and the Western Electric showing the smallest range. With all of the five methods there was a high correlation between speech loss and percentage loss of hearing. When all five methods of computing percentage loss are put together the correlation with speech loss ranges from .95 to .99. The author reaches the general conclusion that the percentage method for computing hearing loss is more accurate than has been supposed. On the basis of the data it is not possible to state which method of computing the percentage of hearing loss is the best. Further study is indicated.

PALMER, Wichita, Kan. [AM. J. DIS. CHILD.]

A COMPARATIVE ANALYSIS OF THE RESULTS OF TESTING INDIVIDUAL HEARING AIDS IN A SCHOOL FOR THE DEAF. JEAN UTLEY and MARION GOEBEL, Speech Monogr. **10**:40, 1943.

Twenty-one children from the intermediate and advanced departments of the South Carolina School for the Deaf, 14 girls and 7 boys, whose ages ranged from 11 to 20, were studied by various methods of audiometric testing. The deafness of 15 of these children was congenital. Various hearing aids were used in order that their effectiveness might be checked. The aids are not identified in the publication. One aid was of no benefit; when the total percentage loss for speech with the aid was subtracted from the total percentage loss without the aid, it was found that one aid gave the group a gain of 14 per cent, and one aid gave the group a gain of 7 per cent. Some persons who could be helped by none of the devices were helped when the loud speaker system was used. In 1 case one hearing aid apparently actually decreased the hearing of the child who was wearing it. The general conclusion is that several aids should be tried on any severely deaf child and hearing tested with the pure tone audiometer.

PALMER, Wichita, Kan. [AM. J. DIS. CHILD.]

Nose

THE TREATMENT OF EPISTAXIS BY SCLEROSING INJEC-TIONS. SAMUEL L. FOX, Laryngoscope **54**:398 Aug.) 1944.

Fox has been able to control active bleeding and to prevent future bleeding from varicosities of the nasal septum by injecting a sclerosing agent. The agent, sylnasol (a solution of the sodium salts of the fatty acids of psyllium seed oil), is injected intramucosally just beneath the bleeding point. Sometimes several injections are necessary. The side effects are transient and not severe.

HITSCHLER, Philadelphia.

THE COMMON COLD. HARRY ADLER, New York State J. Med. **44**:1797 (Aug. 15) 1944.

Adler is mindful of the enormous literature dealing with colds, but he thinks that a study of several thousand cases in the hospital of the Elmira Reformatory might contribute something of value. The two most useful measures were found to be the giving of vaccines "during the course of the illness" and the spraying with solution of sulfadiazine. Most of the

discomfort comes from the waterlogged nasal tissues and the difficulty of breathing through the nose. "It then follows that any treatment that tends to restore tissue to approximately its normal state should be the treatment of choice. Sodium chloride in large doses abruptly curtails marked serous exudation and thus contributes to the comfort of the patient, shortens the course (of the disease), lessens severity, markedly reduces absenteeism—all this in contrast to medication." It is assumed that the author means internal medication, although vaccines may not be so considered. He also includes ultraviolet radiation and heliotherapy as valuable adjuncts to the ingestion of salt. In this connection it would be interesting to know whether patients who are on a salt-free diet are subject to or are more resistant to colds. In any case this condition which is as old as mankind has not until recently received the scientific study which it merits. Complications of colds are often dangerous, sometimes fatal. If physicians could prevent colds, they could indirectly save life. Since prevention is virtually impossible in a gregarious society where one is frequently exposed to "a person with a cold," it is good to know that early treatment may help to shorten the time of indisposition. The article is full of good information and should be read as a whole.

VOORHEES, New York.

Miscellaneous

THE USE OF PENICILLIN IN DISEASES OF THE EAR. CLIFFORD A. SWANSON and LIEUT. D. C. BAKER JR., J. A. M. A. **126**:616 (Nov. 4) 1944.

Swanson and Baker describe the methods and the results of the use of penicillin in the treatment of diseases of the ear in 5 cases. Among other interesting data they mention in substance some observational details: Penicillin is a powerful antibacterial substance produced by Penicillium notatum in ordinary nutrient broth. It is highly soluble, relatively unstable and easily destroyed by dilute acids. It is hygroscopic and rapidly loses its activity if exposed to air, but it retains its activity for twenty-four hours if absolutely dry. Penicillin is not affected by pus, blood, serum or the products of the breakdown of tissue. The number of organisms has little effect on its bacteriostatic action. Penicillin inhibits the growth of bacteria, while the body defenses, humoral and cellular, destroy the organisms. Purified penicillin in dilution of 1:25,000,000 will completely inhibit the growth of Staphylococcus aureus and is free from toxic reactions. According to Dawson and Hobby, the establishment of the correct dosage and the frequency of administration are problems of great complexity.

The Penicillin Committee at the National Naval Medical Center believes that the intramuscular administration of the drug is the most practicable.

The authors summarize their article as follows: A study was made of the use of penicillin in diseases of the ear. The drug was found to be of value in the treatment of acute otitis media, acute mastoiditis, acute labyrinthitis and chronic otitis media. A technic was developed for the administration of penicillin: It is instilled into the external canal and the middle ear as well as into the postoperative mastoid cavity. Penicillin has been employed with substantial benefit in many instances in which other forms of therapy had failed.

It was possible either to avoid surgical intervention for acute mastoiditis or to use the drug as a supplement to surgical treatment with significant help.

When the drug is instilled into the mastoid cavity after operation, healing is prompt and the period of convalescence is shortened. Penicillin is the ... powerful chemotherapeutic agent available to ... acute otitis media, acute mastoiditis and their ... cations.

GORDON, Philadelp...

USES OF PENICILLIN IN DISEASES OF THE NOSE ... THROAT. F. J. PUTNEY, J. A. M. A. **12...** (Nov. 4) 1944.

Putney discusses the uses of penicillin, cover... series of 19 cases. He cautions that penicillin ... not be used indiscriminately. The general grou... cocci were found to be sensitive to penicillin.

Originally penicillin was administered intraven... either by repeated venous punctures or by contin... drip, but the intravenous has been supplanted by ... intramuscular injection. The dosage employed is ... units injected intramuscularly every three hours ar... the clock, to be reduced to 15,000 units when ... patient shows improvement. Local as well as syst... administration proved to be more helpful in som... the cases. The acute diseases gave the most dra... results; in chronic diseases the response has been ... to evaluate.

Various methods are discussed and the results ... ported. Several irrigations of the maxillary ... cured acute infections of these sinuses. Cases of o... myelitis, orbital cellulitis, thrombosis of the caver... sinus (death occurred on the eleventh day of therap... this case), abscess of the brain, peritonsillar ... lateral pharyngeal abscesses were commented on.

The author emphasizes that "penicillin in com... tion with adequate surgical treatment offers the ... effective means of combating some of the serious and ... endangering complications encountered in otola... gology."

ABSTRACT OF DISCUSSION

MAJOR ELMER A. VORISEK, M.C., A.U.S.: ... was found that even penicillin could not re... adequate surgical intervention and proper drainage.

MAJOR WALTER J. AAGESEN, M.C., A.U.S.: ... our practice to give 25,000 units of penicillin in... muscularly every three hours day and night for tw... to fourteen days. Especially is this true when ... offending organism is the staphylococcus. ... The sensitivity of different strains of staphyloco... to the action of penicillin varies considerably.

COMMANDER E. E. KOEBBE, M.C., U.S.N.R.: ... use 15,000 units of penicillin [intramuscularly] e... three hours around the clock for about seven days ... until the drum has resolved and the landmarks re... Then we reduce it to 10,000 and keep that up three ... four days, then 5,000 for three or four days. ... [In otitic meningitis after establishment of ... diagnosis] by lumbar puncture and neurologic findi... we give 15,000 units intrathecally. We do not re... that oftener than every twenty-four hours.

[Captain Robert Henner, of Barksdale Field, ... stated that favorable results were obtained by u... heparin and penicillin in venous thrombosis as poi... out in the work of Schall.]

CAPTAIN F. J. PUTNEY, M.C., A.U.S.: I sho... like to confirm the observation that lateral s... thrombosis must be operated on as well as tre... with penicillin.

CAPTAIN C. A. SWANSON, M.C., U.S.N.: We h... had only 3 cases in which penicillin was used loc... in the mastoid wound and all 3 cases were healed ... 8 days.

LIEUTENANT COLONEL JOHN E. L. KEYS, M... A.U.S.: Those of us in the armed services have ...

unities to study penicillin that were not available colleagues at home; therefore it seems only and right that we should pass on to them at tage, when penicillin is becoming available to the result of our studies so that they may now s in further study of the usefulness and limita- of this drug.

GORDON, Philadelphia.

ATOLOGIC DISEASES FREQUENTLY ENCOUNTERED BY OLARYNGOLOGISTS. A. BENSON CANNON, New rk State Med. J. **44**:1661 (Aug. 1) 1944.

non, associate professor of dermatology at Co- University, read this paper at the meeting of the York State Medical Society in May 1943 at o. He finds that in many instances otolaryn- sts fail to recognize conditions common in the e of dermatologists. Among these are syphilis, igus, leukoplakia and lichen planus. Certain such as phenolphthalein, cause lesions in the Owing to the activities of the gentlemen of dio and detail men, physicians are too vitamin con- ; therefore, many conditions diagnosed as avi- sis turn out to be quite different and more s in Dr. Cannon's experience. Even carcinoma en so mistaken. Local irritants cause leukoplakia- sions, which recede promptly on withdrawal of use. But there is a type of leukoplakia due to n deficiency, and so confusion may become worse nded. Stomatology has been well studied, and are many good books on the subject, but illustra- are of little use unless colored. Dr. Cannon's were kodachrome reproductions. In this publi- black and white figures had to suffice. They adequate but do emphasize the importance of the ngologist's being well schooled in oral diagnosis.

VOORHEES, New York.

TREATMENT OF MENINGITIS WITH PENICILLIN INJECTED INTRAVENOUSLY AND INTRAMUSCULARLY. ALLISON HOWE PRICE and JOHN H. HODGES, New York State J. Med. **44**:2012 (Sept. 15) 1944.

Working in the Jefferson Medical College and Hospital, Philadelphia, Price and Hodges were provided with penicillin through the National Research Council. Seven patients suffering from meningitis of various types were treated with this drug, 5 of whom recovered. Two died. One of these had complicating diabetes; the other, hyperthyroidism. Price and Hodges state that the trend of opinion in regard to spinal puncture is that it should be used to determine the diagnosis or the effect of therapy or to relieve intracranial pressure. They are convinced that the intravenous and intramuscular methods of administering penicillin are just as effective as the intraspinal (they used the word "intrathecal"). They describe in detail the daily course of their patients. Penicillin was given by the intravenous drip method to the amount of 100,000 units in every twenty-four hours for five days or longer (in case 1, for two weeks). This dosage was then continued intramuscularly until the patients were symptom free. The organisms were pneumococci, staphylococci and meningococci. In summary the authors say: "Two patients with acute meningitis complicated by other systemic disease died a few hours after penicillin was begun. Five patients with coccic meningitis were successfully treated with penicillin injected intravenously or intramuscularly without intrathecal therapy." In an addendum they state that after the report went to press two more patients with meningococcic meningitis were thus successfully treated. The case reports are well done and should be read in their entirety.

VOORHEES, New York.

Directory of Otolaryngologic Societies *

NATIONAL

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President: Dr. Harold I. Lillie, Mayo Clinic, Rochester, Minn.

Secretary: Dr. Arthur W. Proetz, Beaumont Bldg., St. Louis.

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Place: Drake Hotel, Chicago. Time: May 28-29

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Place: Drake Hotel, Chicago. Time: June 1-2

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* Secretaries of societies are requested to furnish the information necessary to keep this list up to date.

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